Biomechanics of feeding

Feeding

- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile

- Feeding on plants: **herbivory**

Feeding

- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile
- Feeding on plants: **herbivory**

Suction Feeding

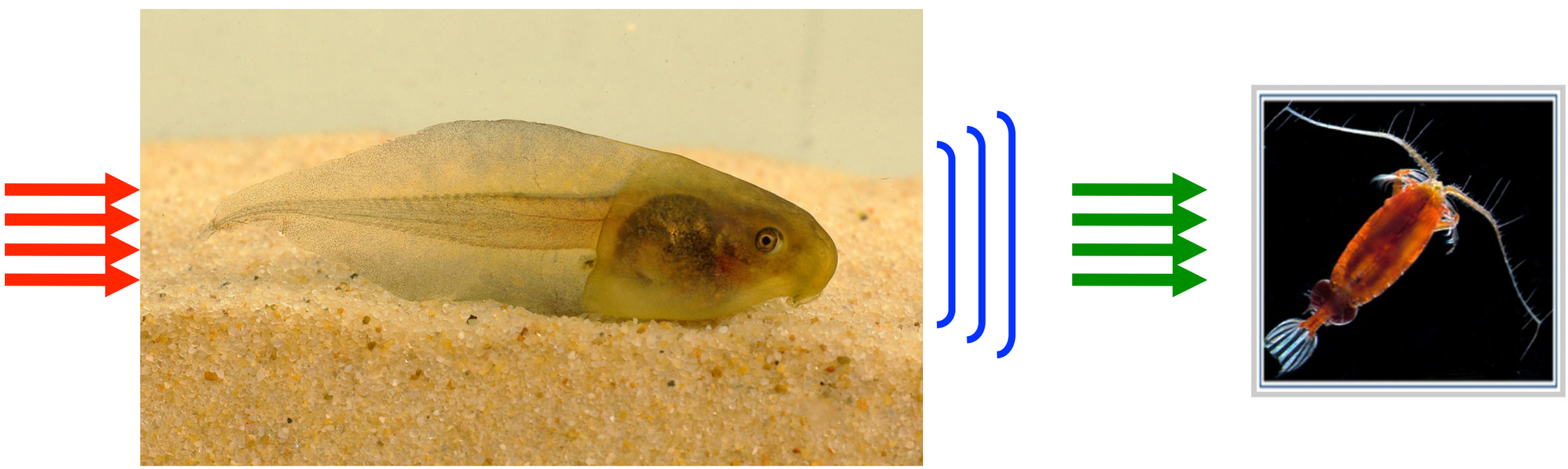
- Physical properties of water determine feeding techniques
- Example: predator movement makes prey move away by pressure waves

Suction Feeding

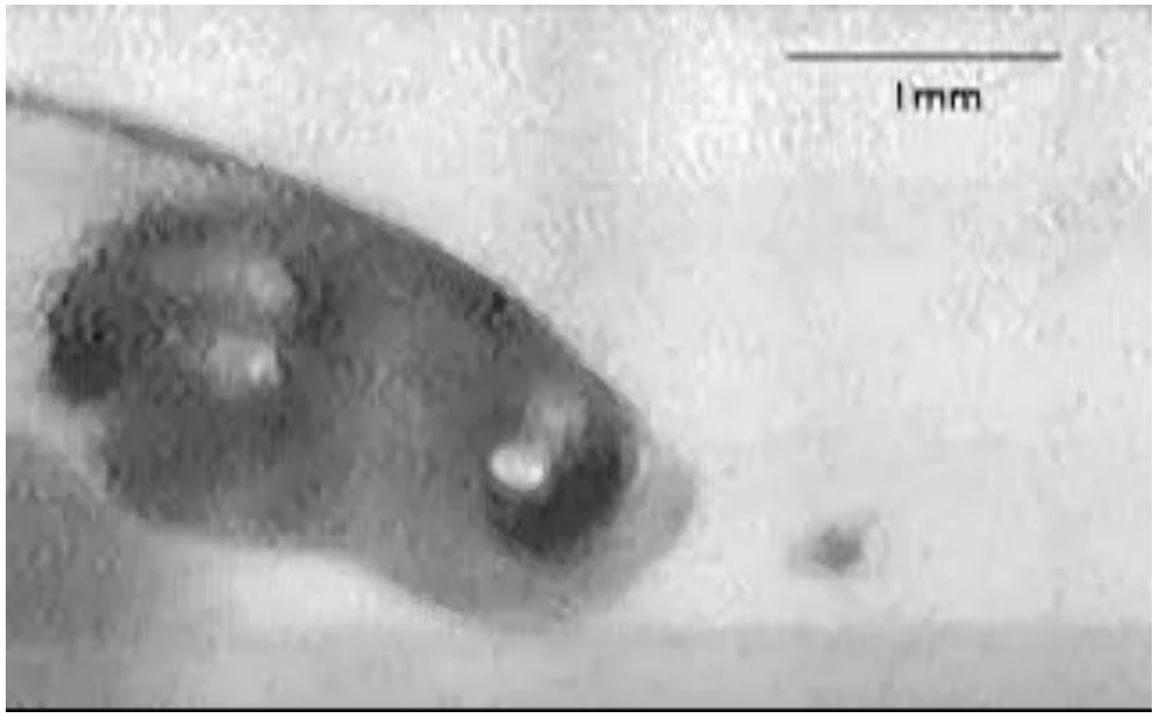
- Physical properties of water determine feeding techniques
- Example: predator movement makes prey move away by pressure waves

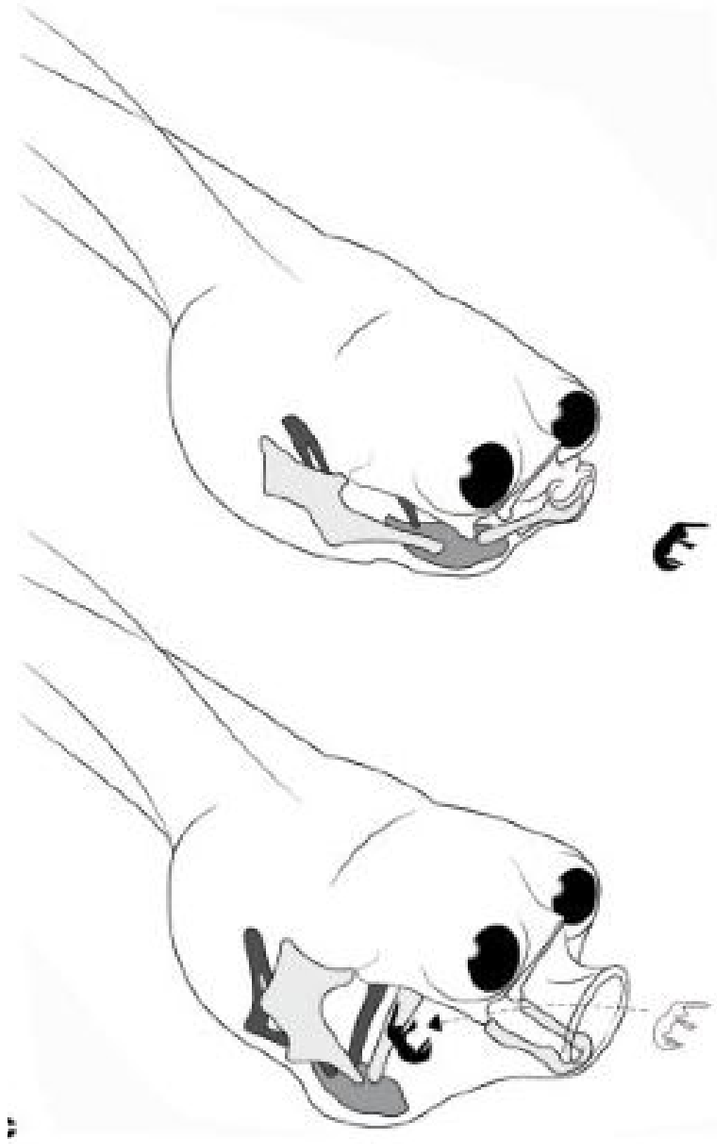
Suction Feeding

- Physical properties of water determine feeding techniques
- Example: predator movement makes prey move away by pressure waves



Suction Feeding

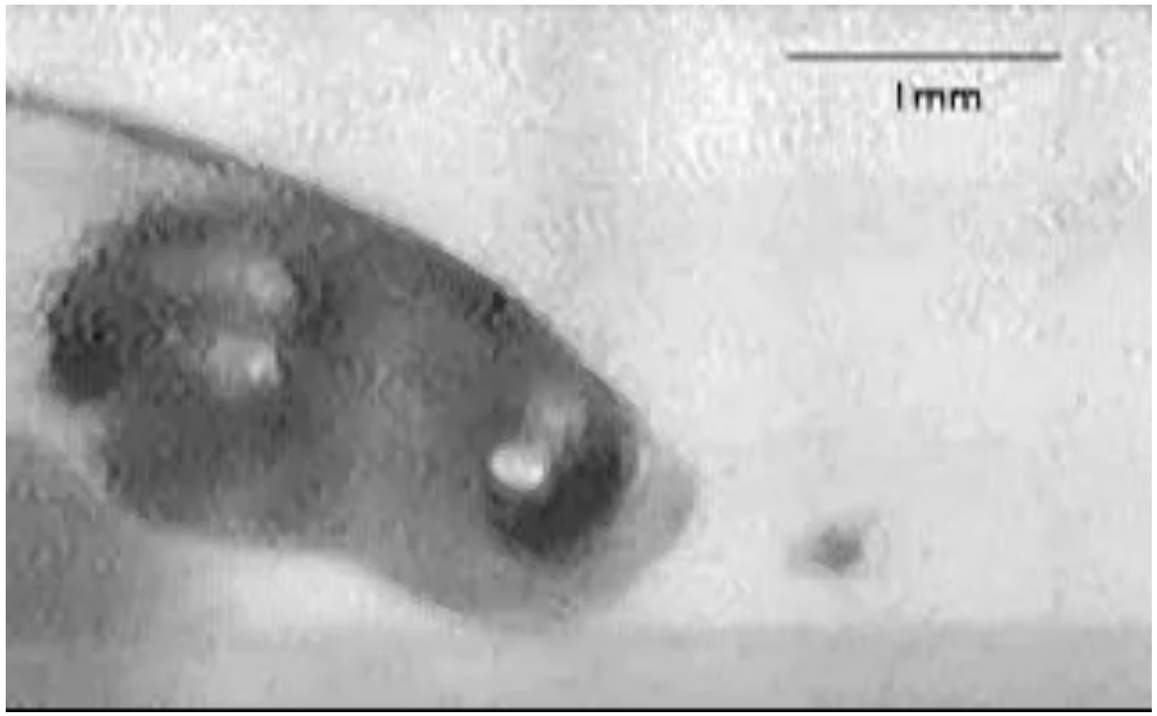


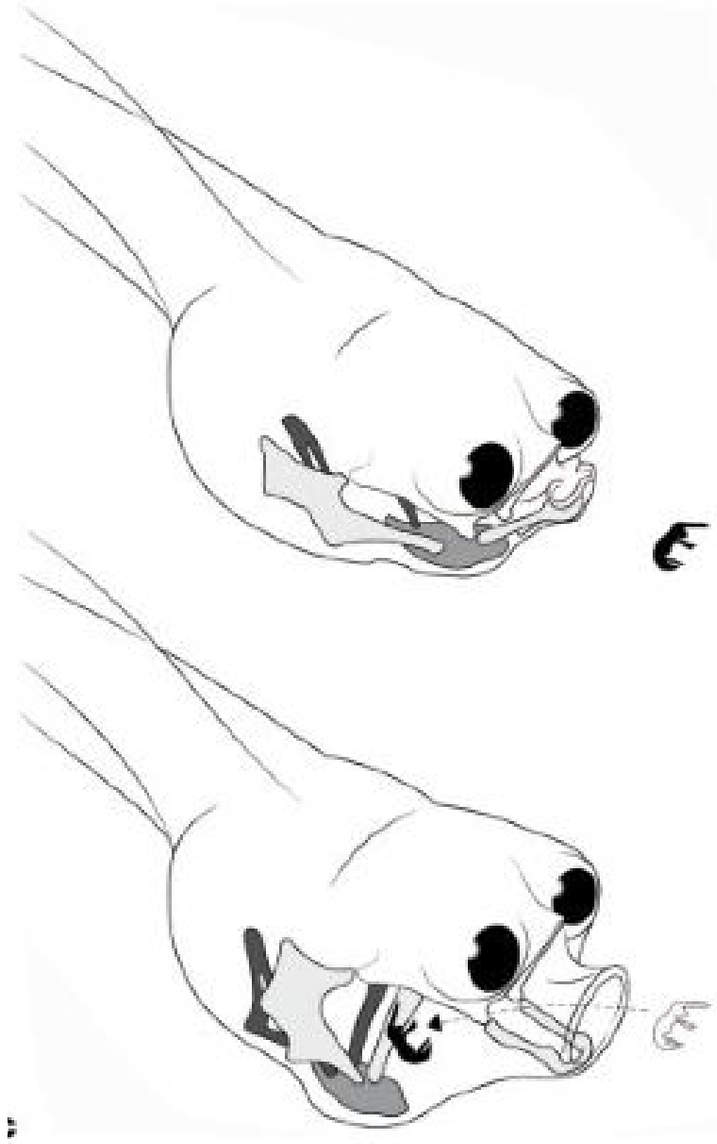


Hymenochirus boettgeri tadpole

S. M. Deban

Suction Feeding



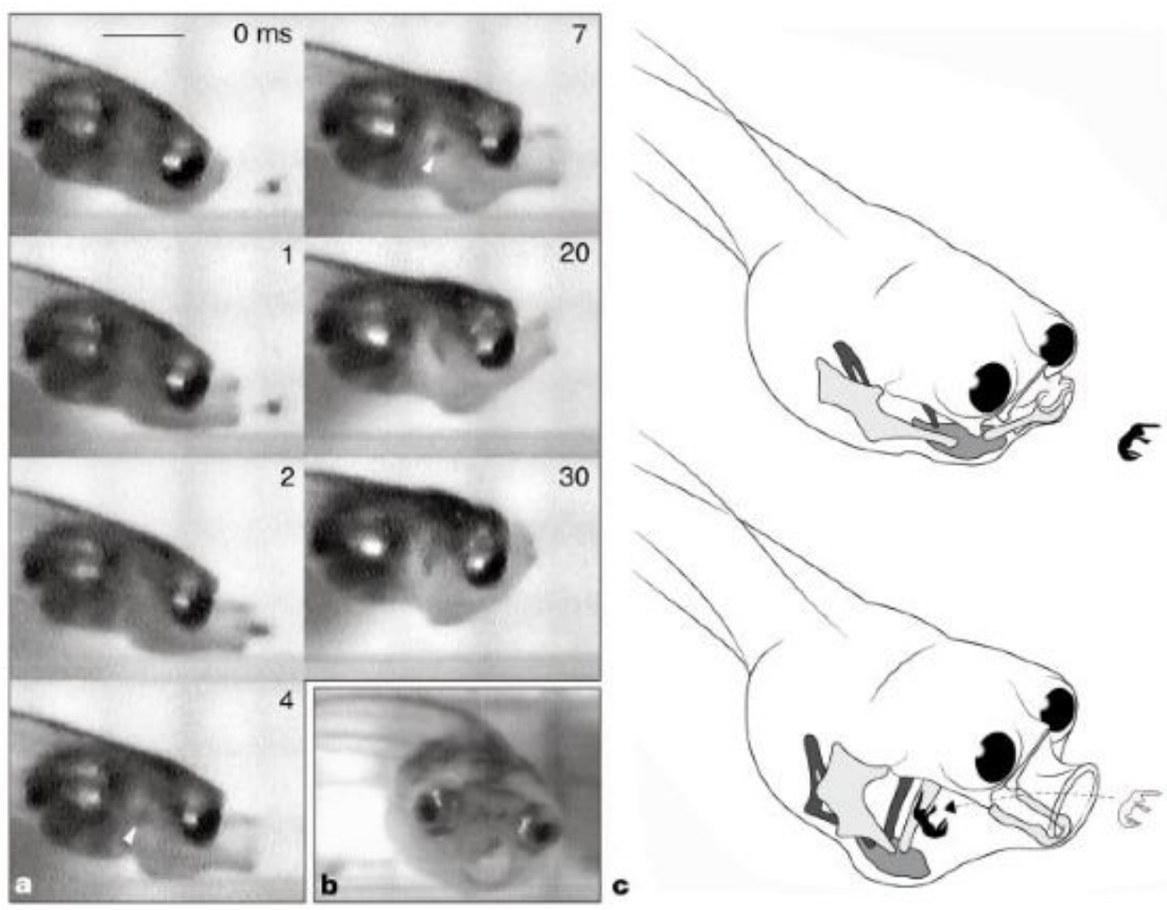


Hymenochirus boettgeri tadpole

S. M. Deban

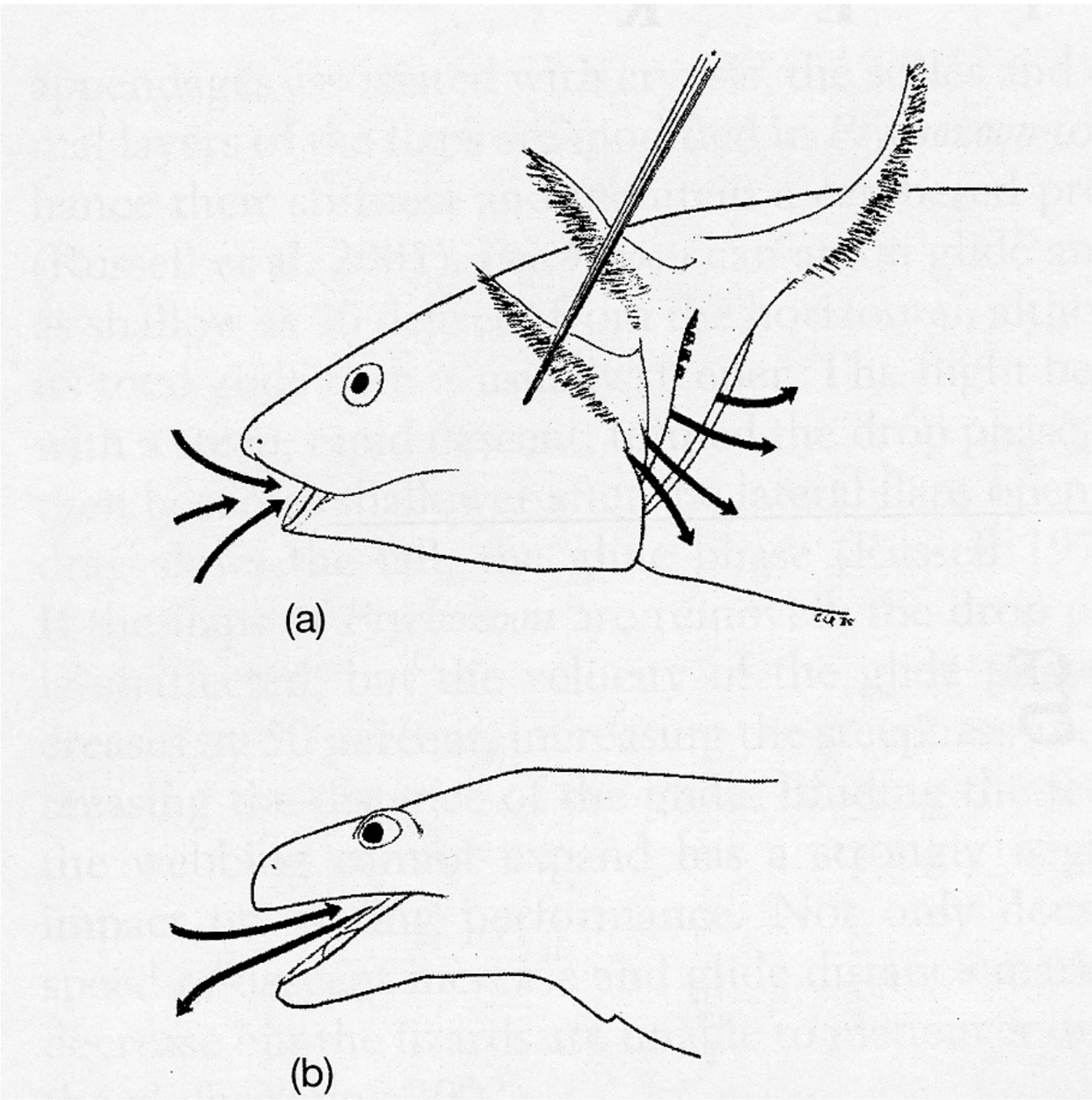
Suction feeding

- Generate negative pressure in the buccal cavity
- Must be rapid, directed



S. M. Deban

Path of Water Flow



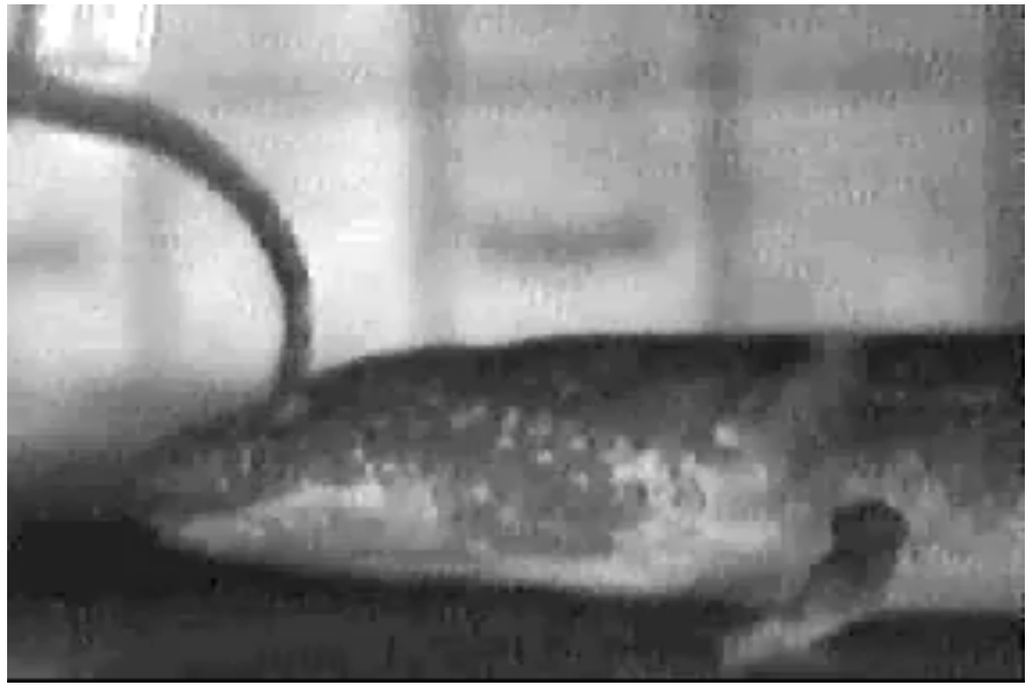
Unidirectional

Bidirectional

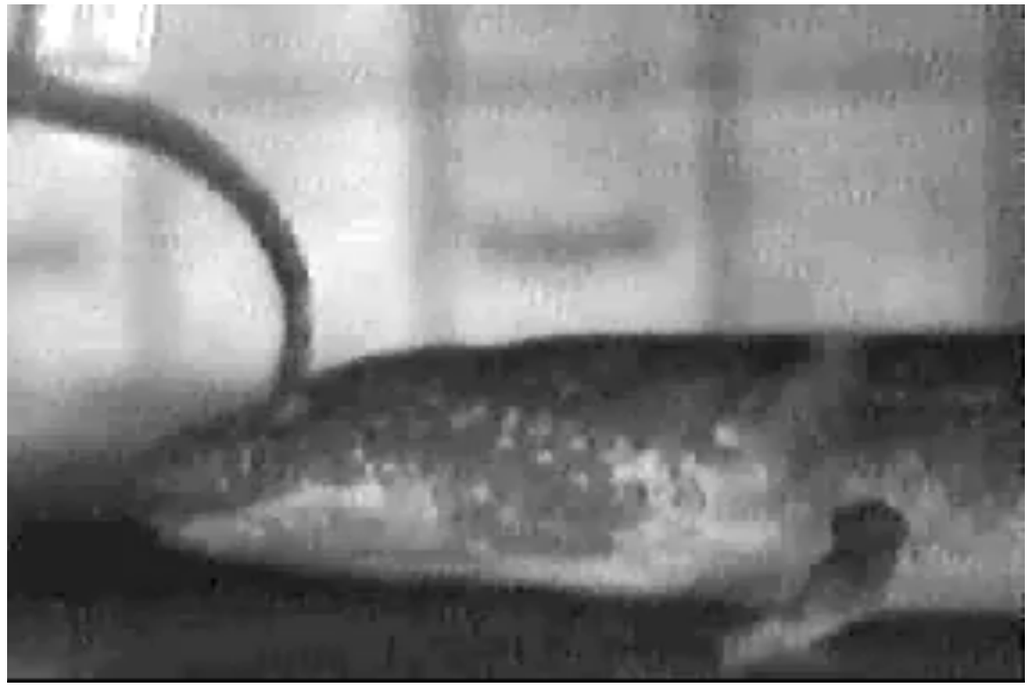
Suction Feeding in Salamanders

- Larval salamanders and paedomorphic adults - unidirectional flow
- Expansive phase
  - Use hyoid apparatus
  - Expand buccopharyngeal cavity
- Compressive phase
  - Adductor mandiblulae muscles
  - Water forced through branchial slits

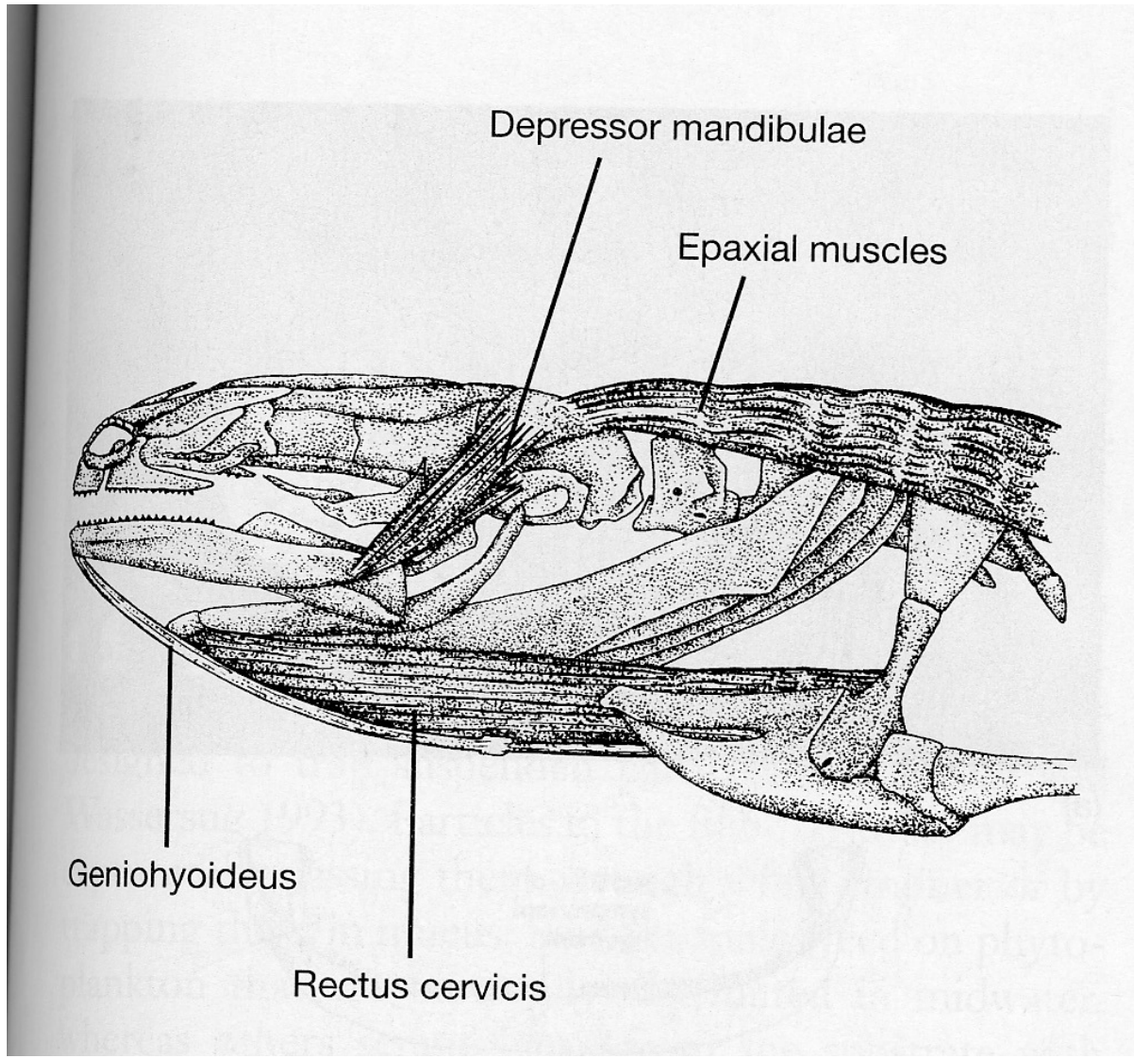
Suction Feeding in Salamanders

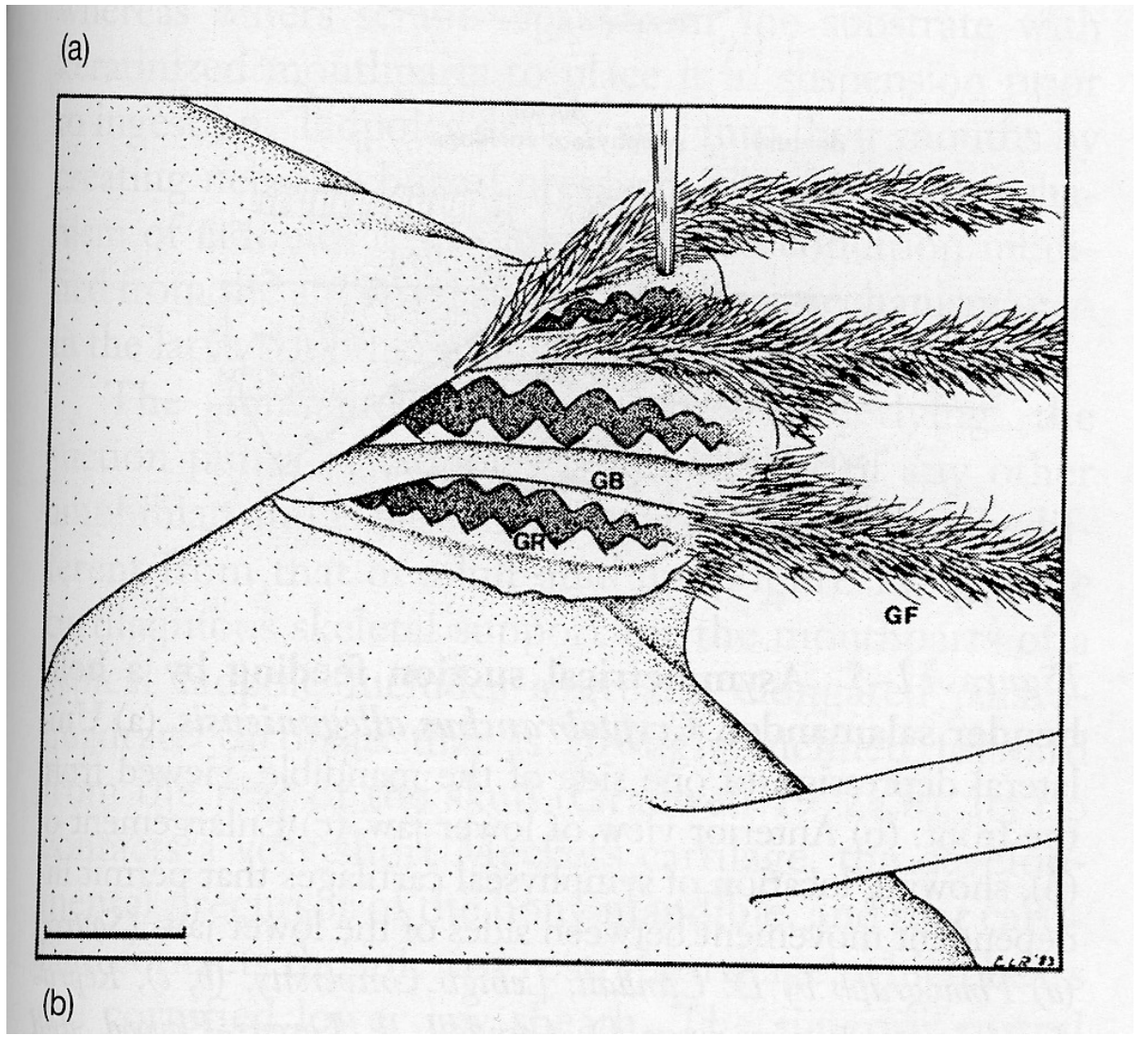


Suction Feeding in Salamanders



Suction Feeding in Salamanders



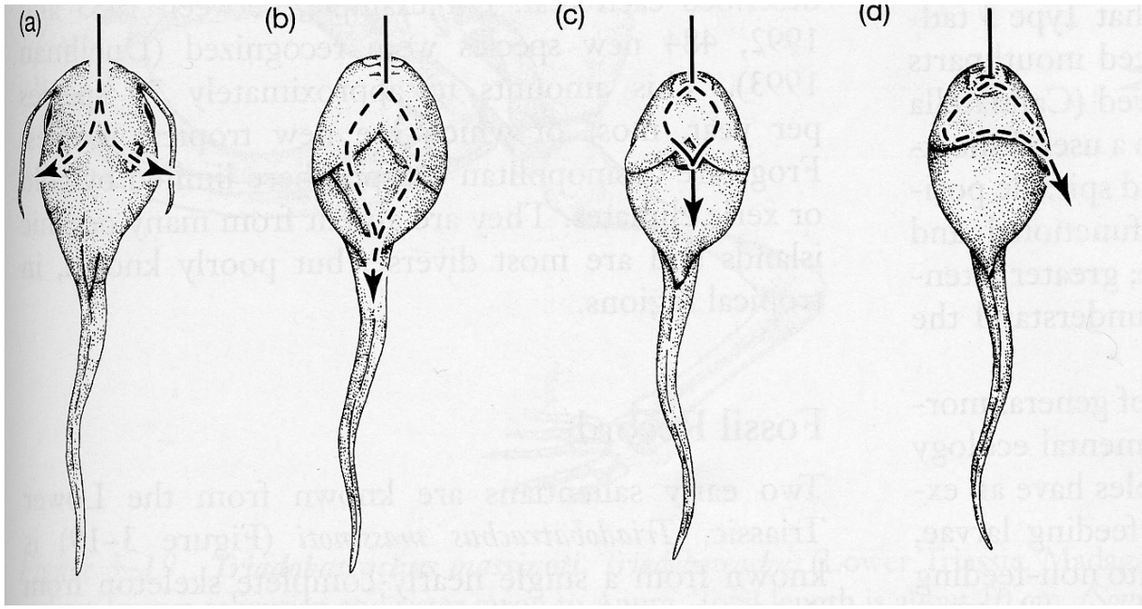


Labial Lobes

Amphiuma means

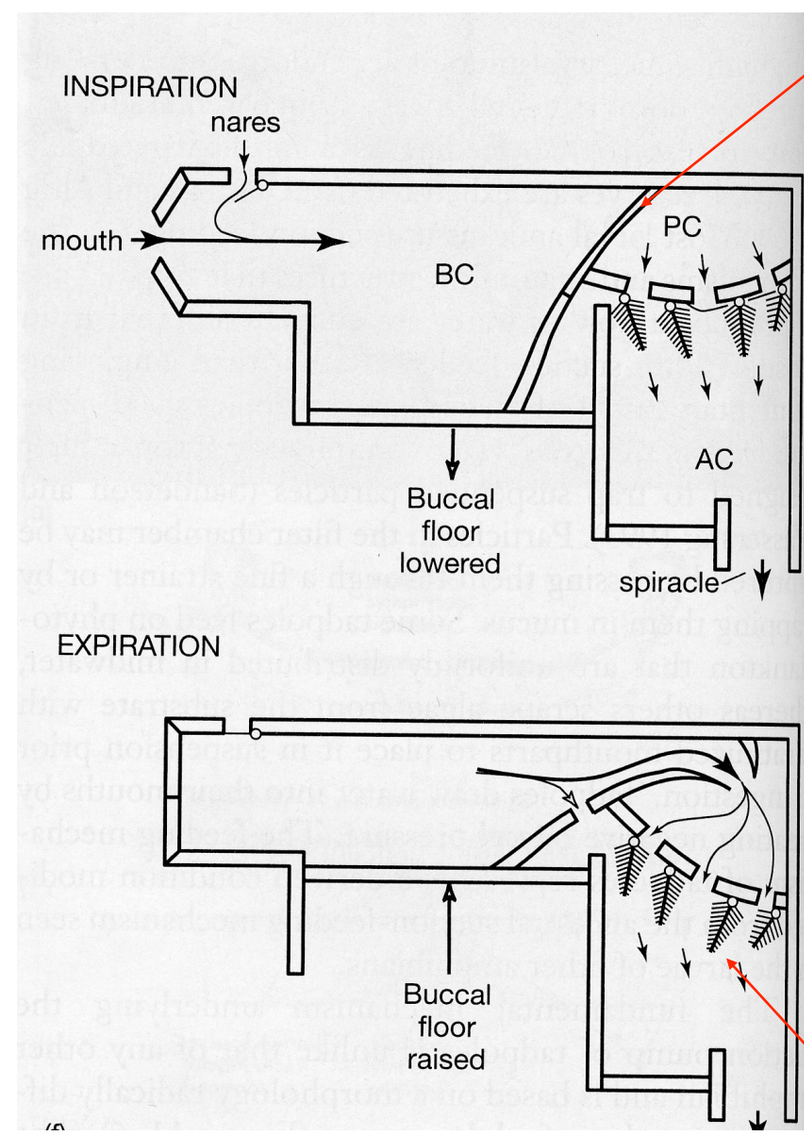
Frogs

- Tadpoles, Pipidae use suction feeding
- Tadpoles are filter feeders
  - Unidirectional
  - Continuous flow

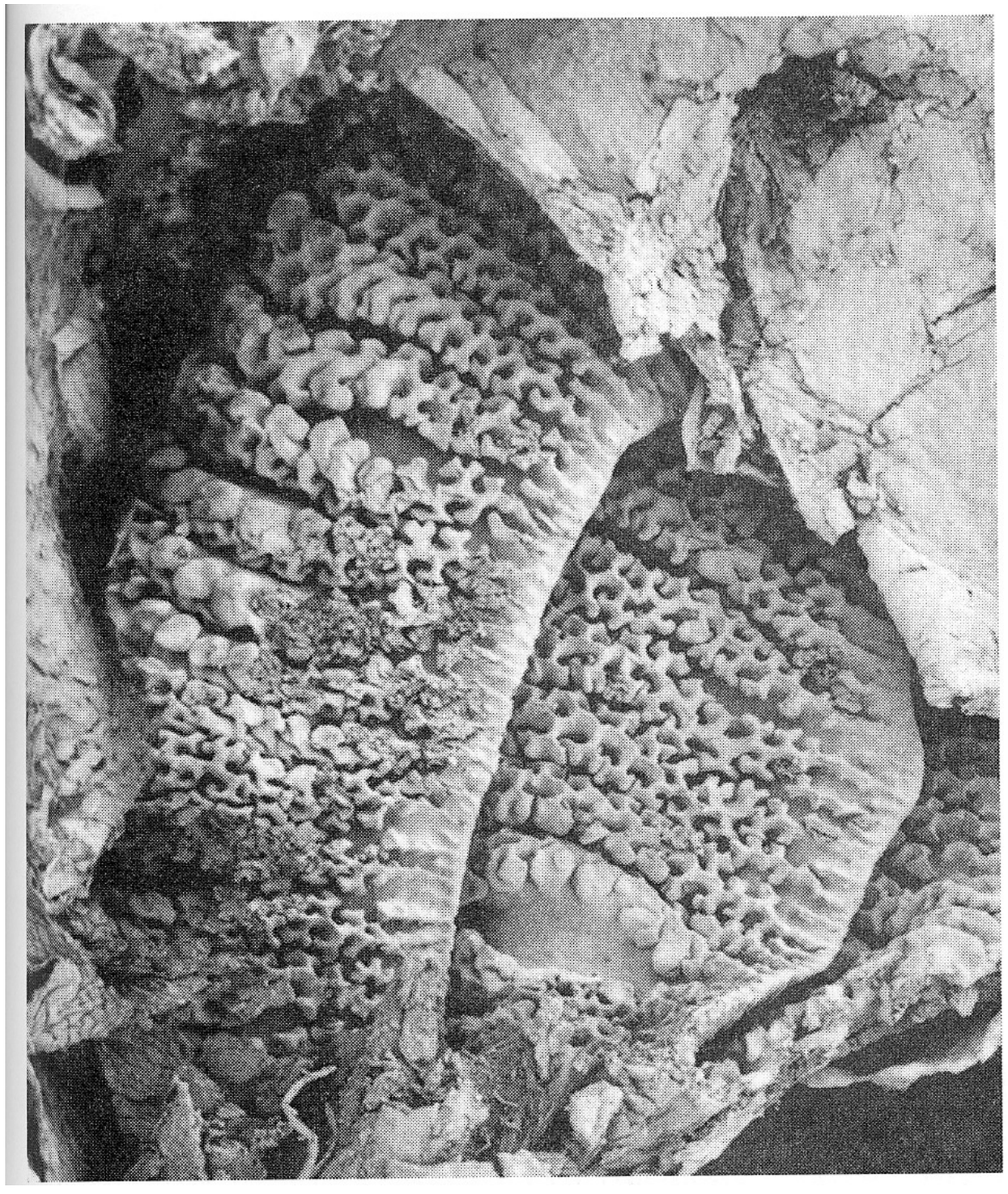


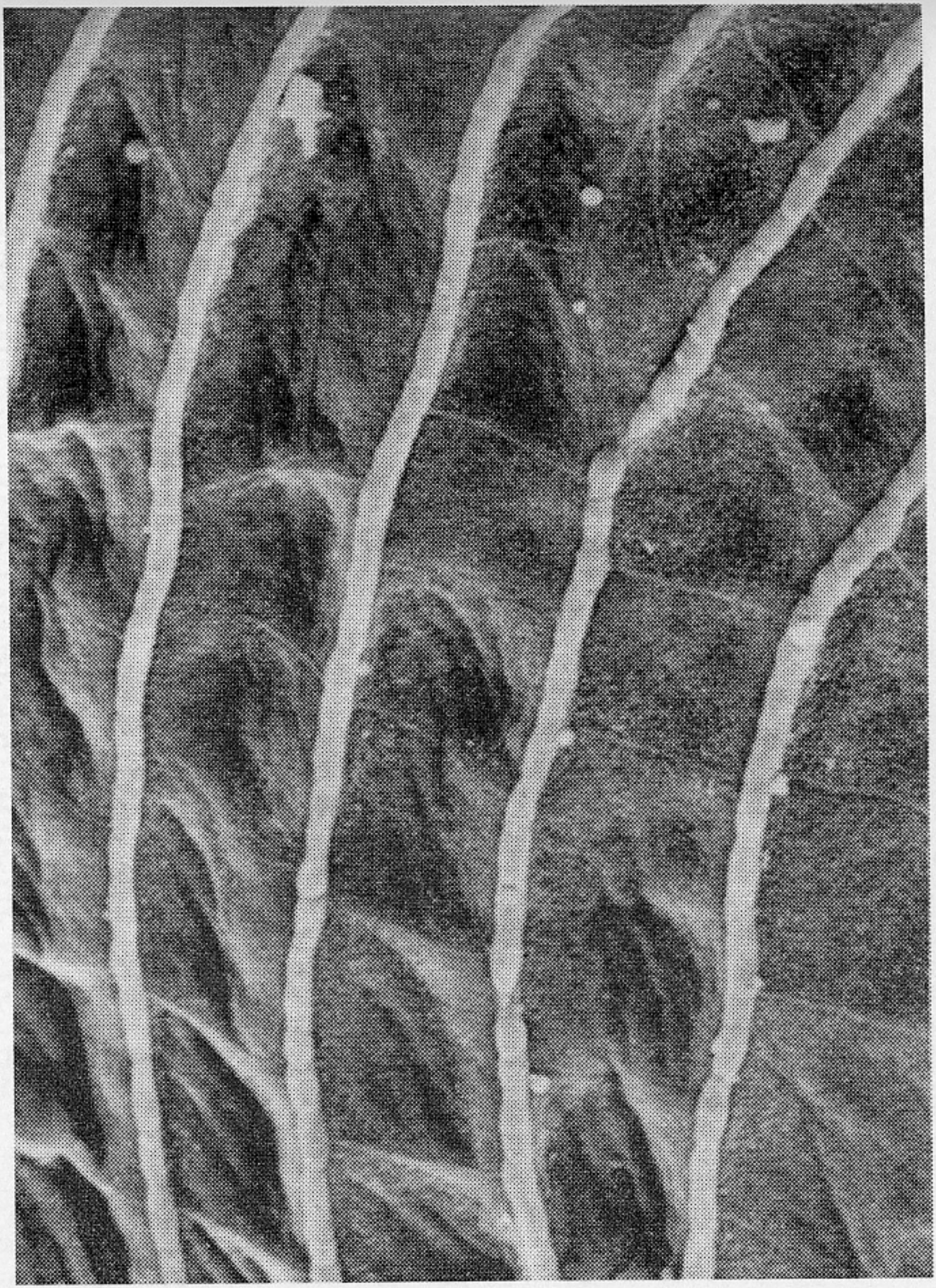
Filtration in Tadpoles

- BC = buccal cavity
- PC = pharyngeal chamber
- AC = atrial cavity



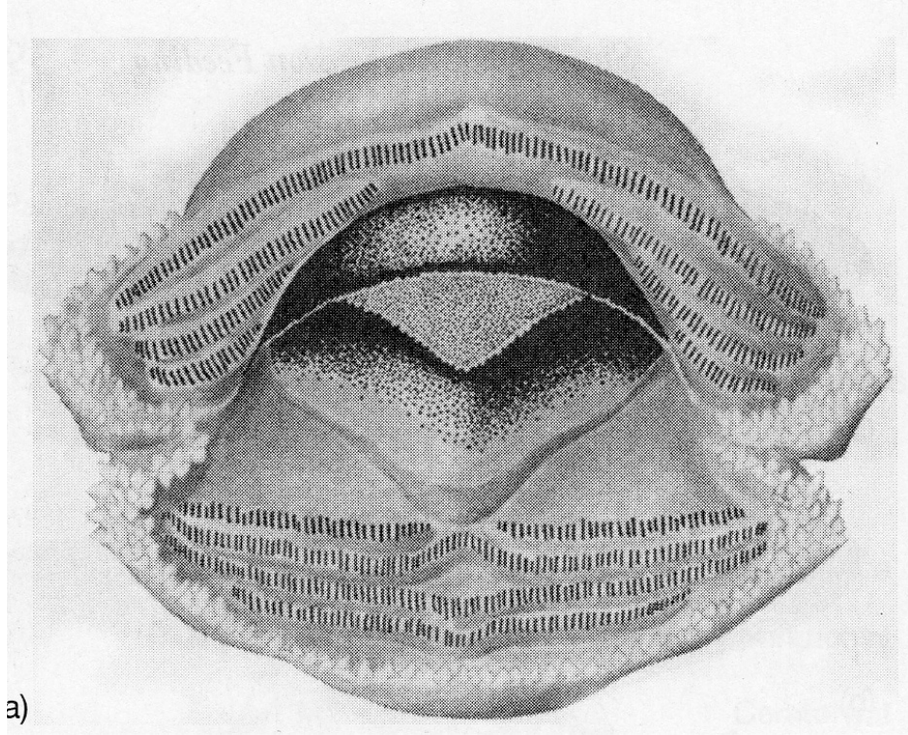
Branchial Filters in a Tadpole

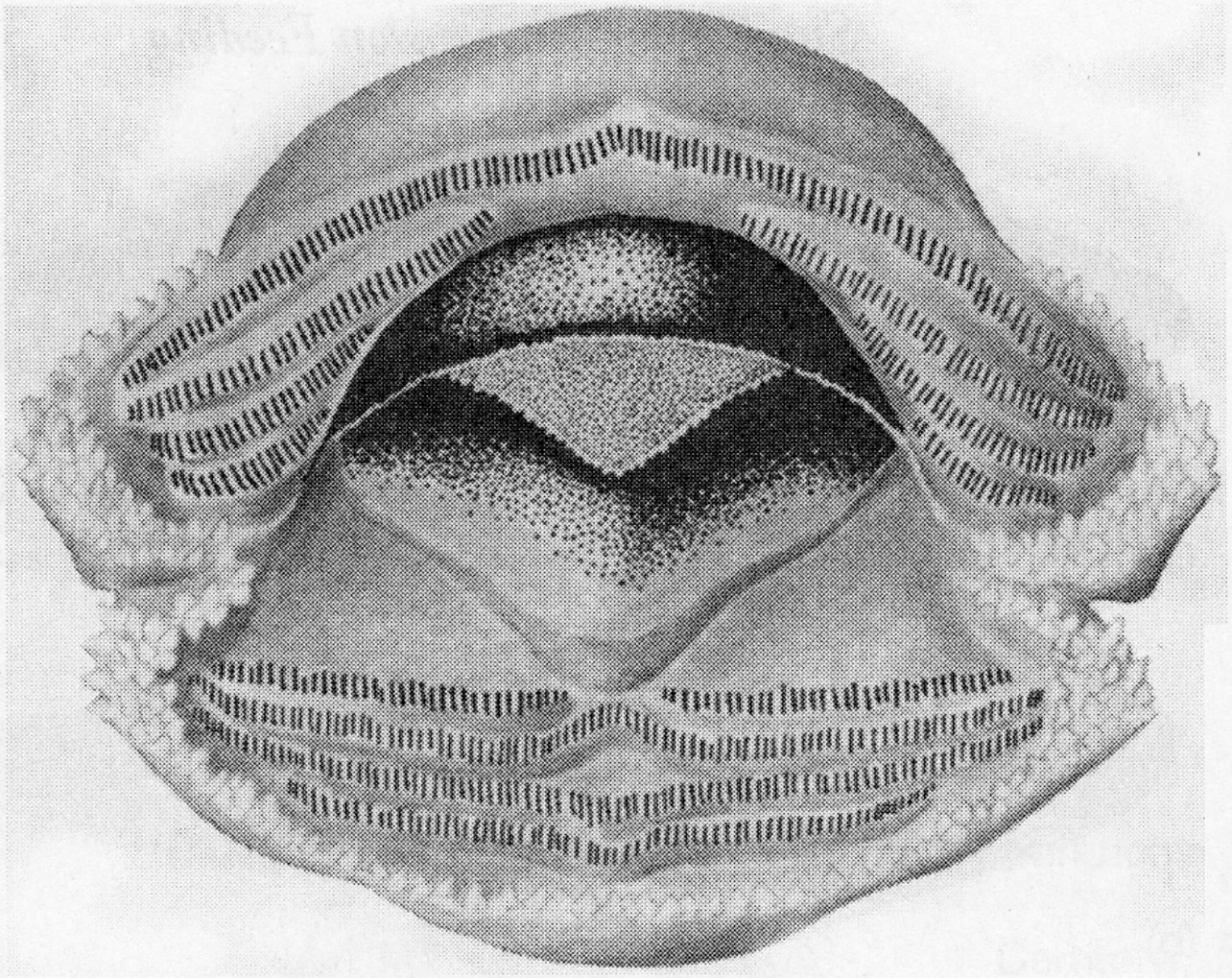




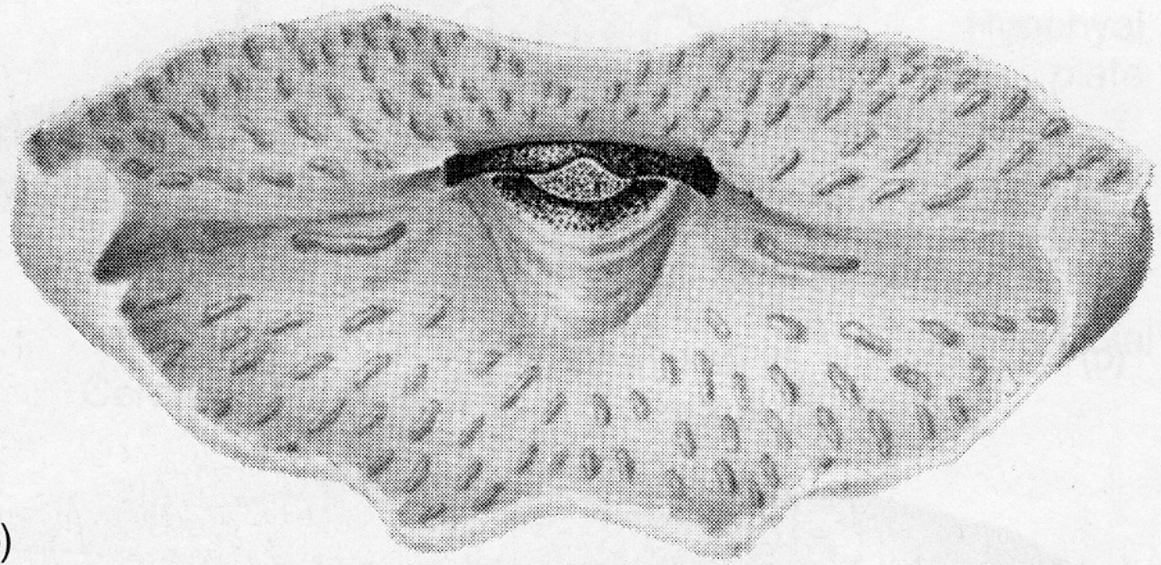
Tadpole Denticles

- Made of keratin
- Scraping and attachment to surfaces

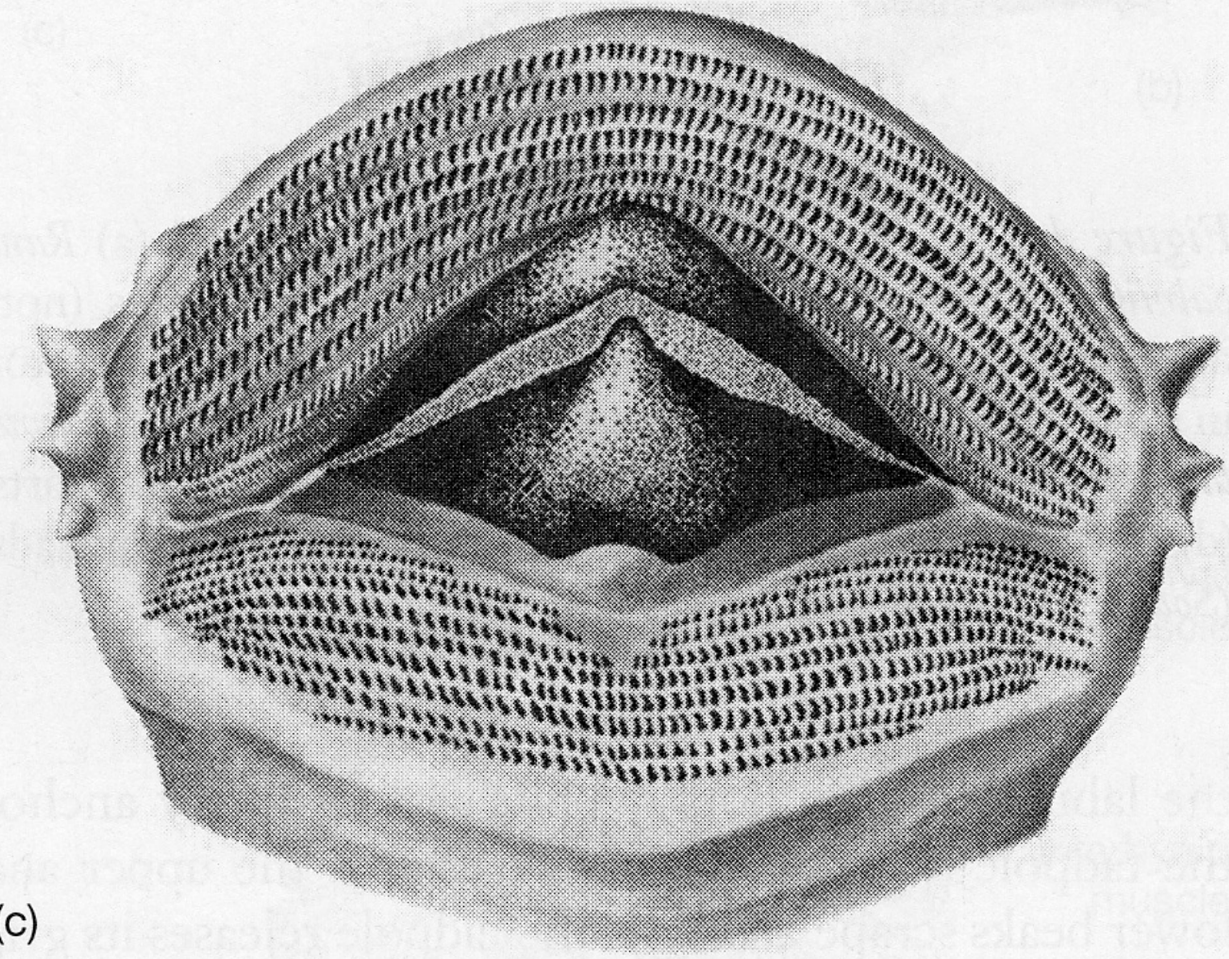




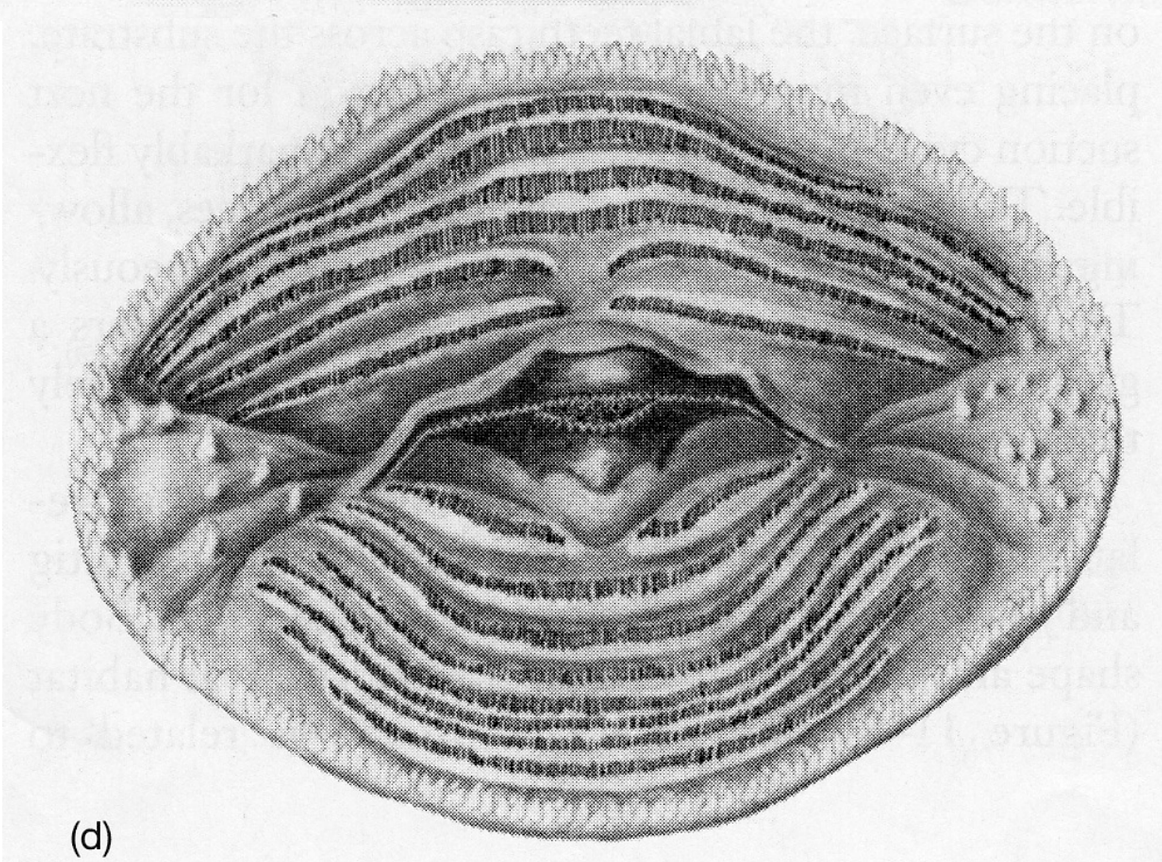
(a)



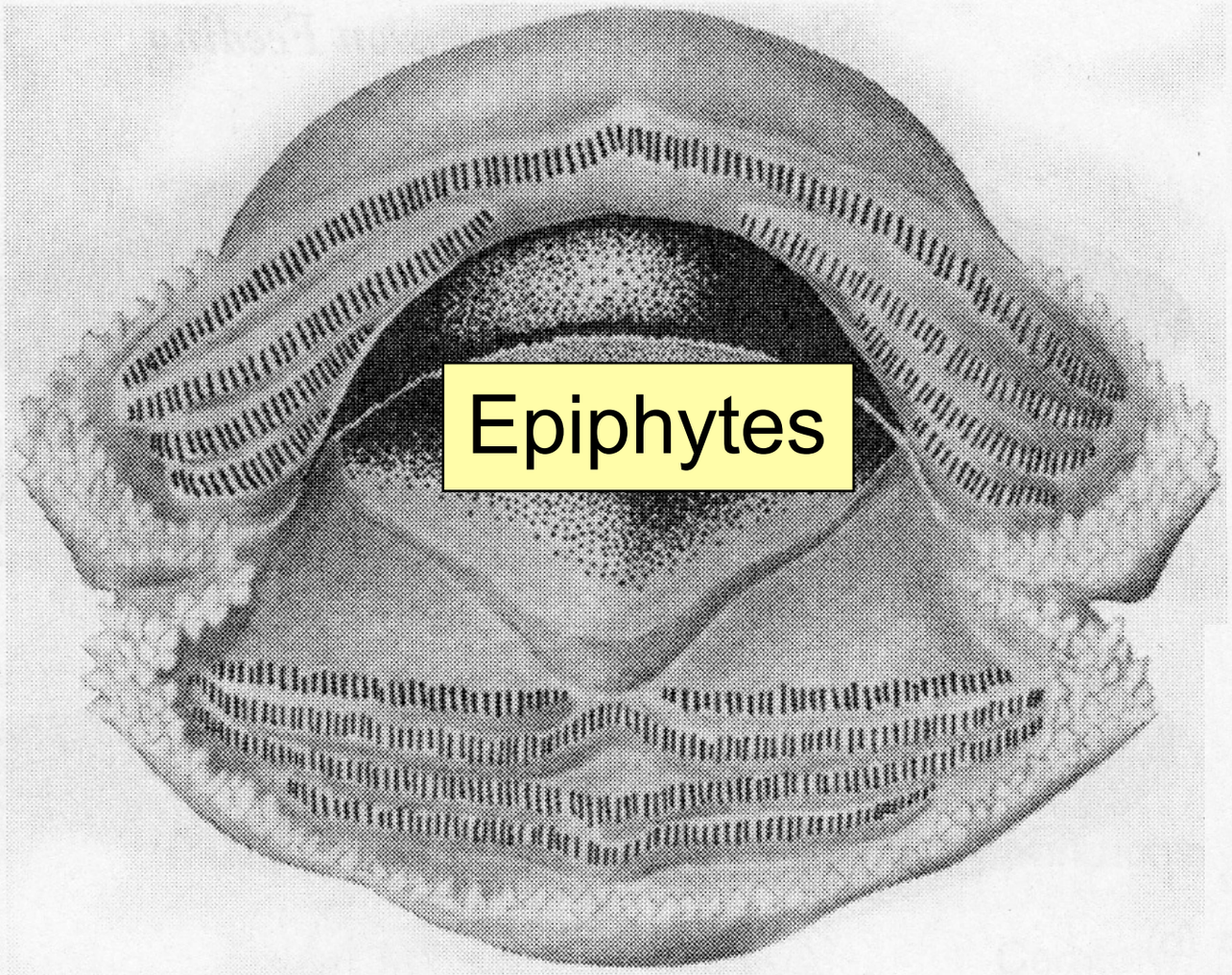
(b)



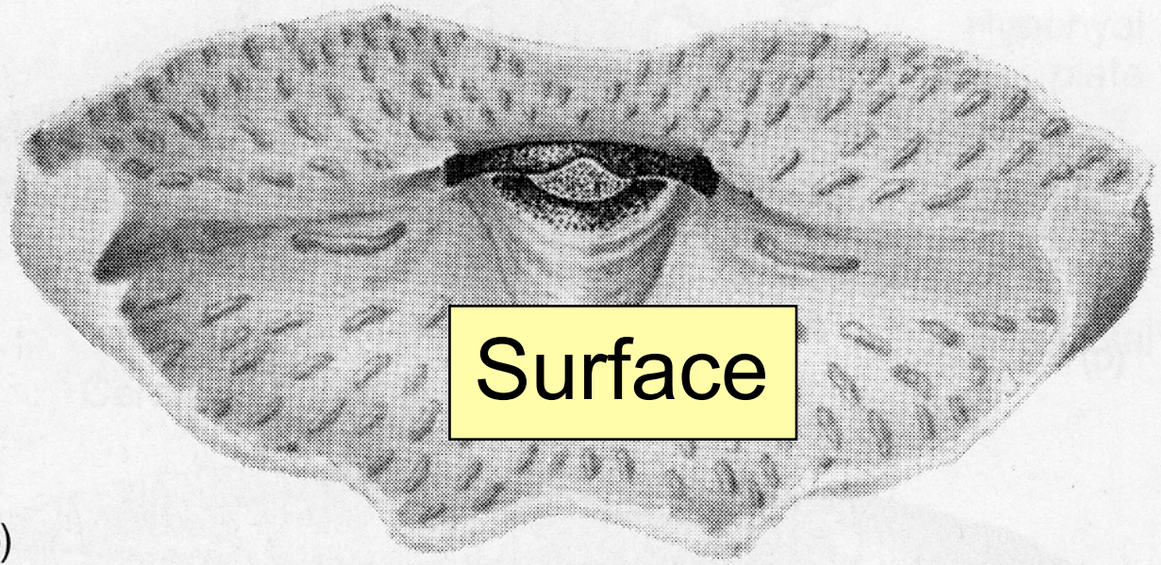
(c)



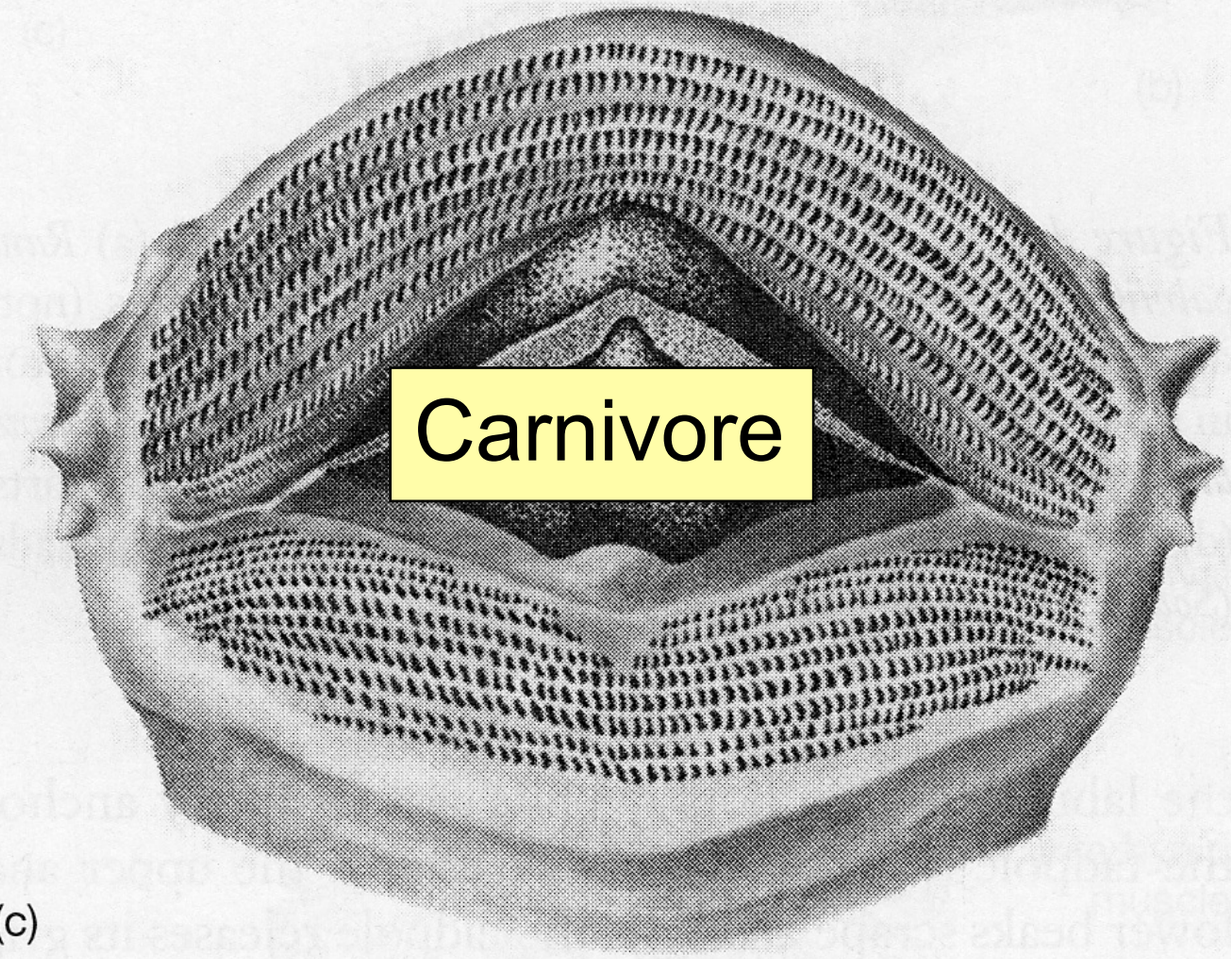
(d)



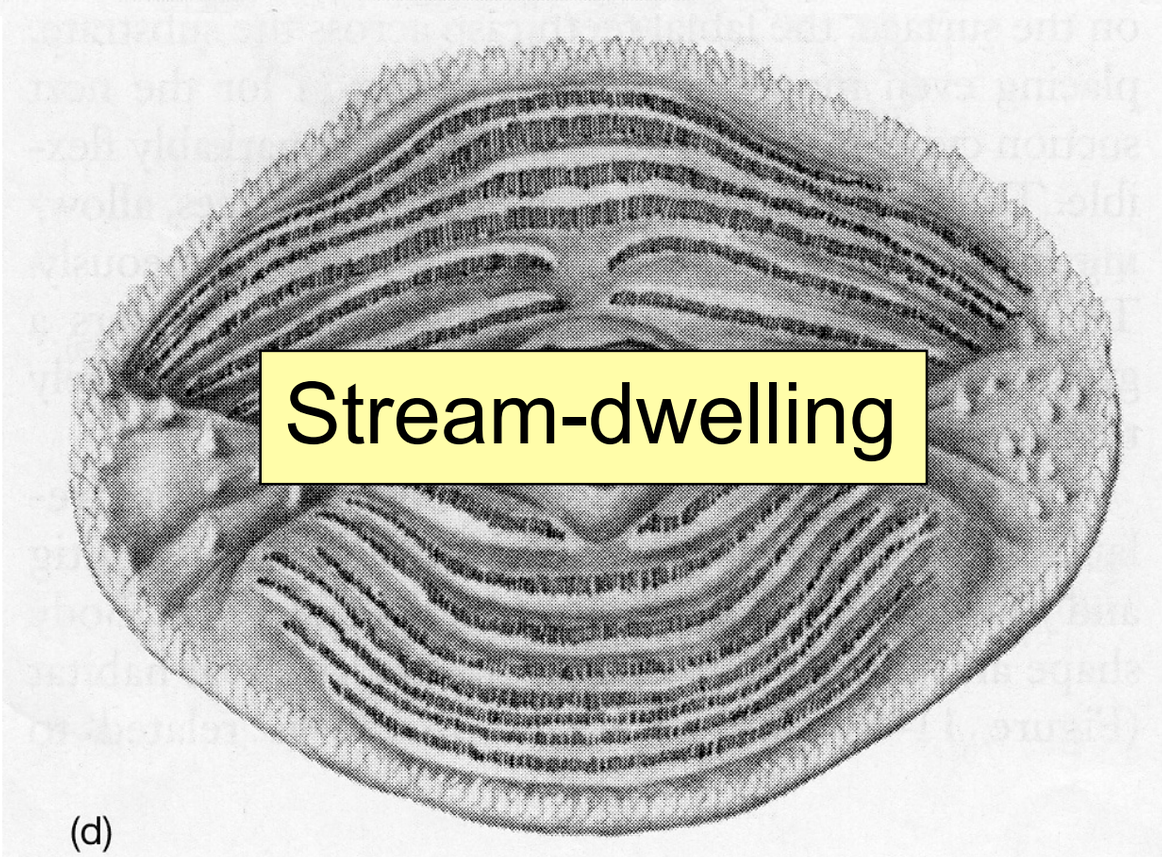
(a)



(b)



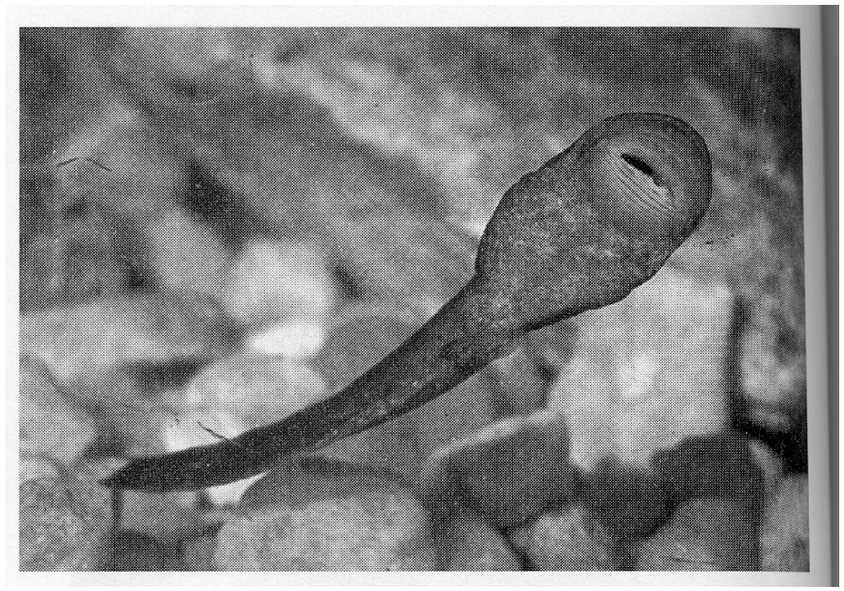
(c)

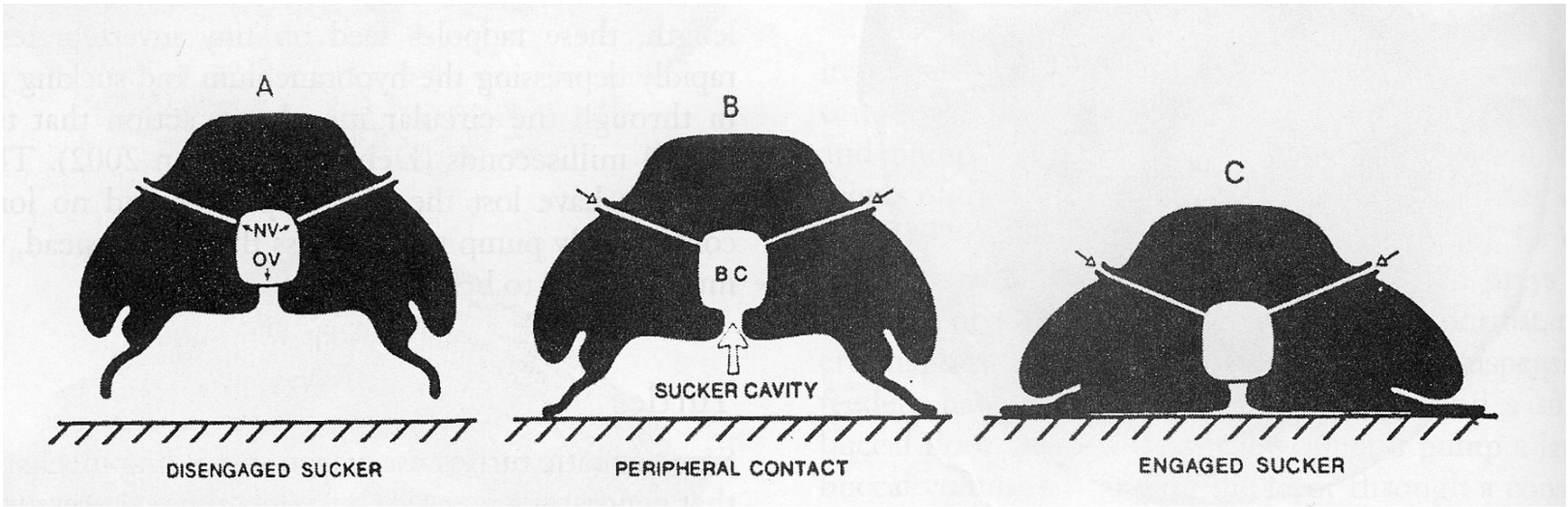


(d)

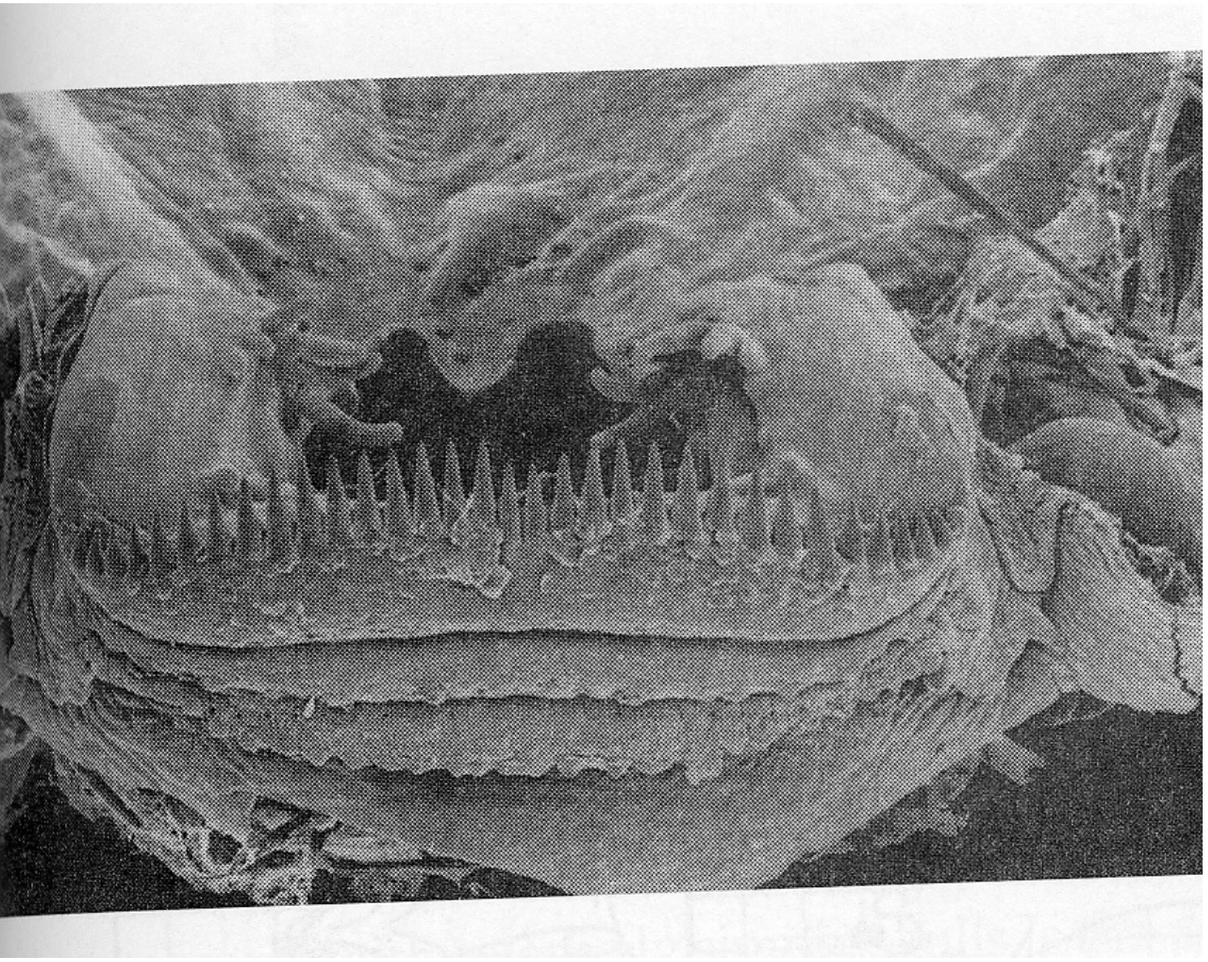
Tadpole Ecomorphology

- Different body forms specialized to diet and habitat
- Example: Deep tail fin for slow-moving waters

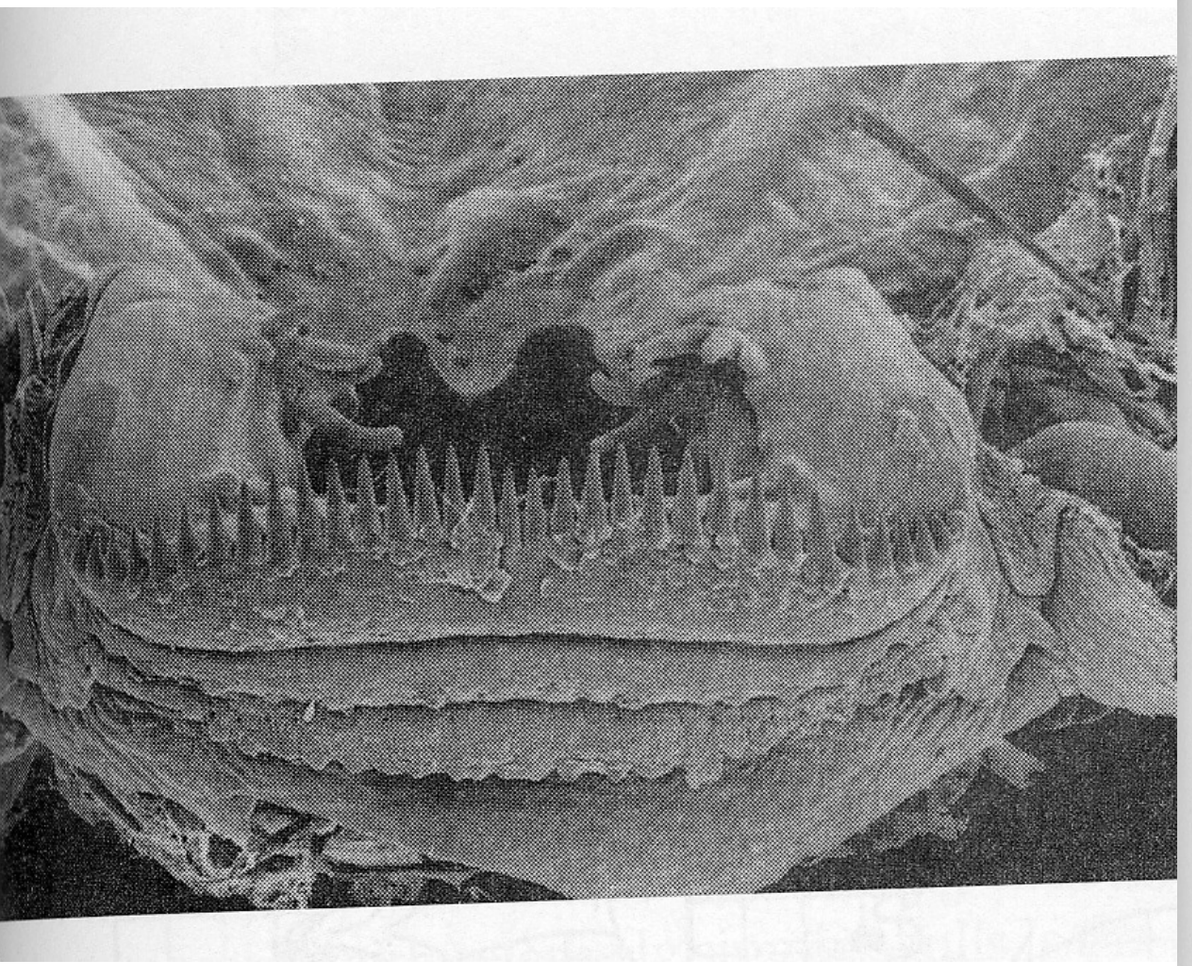




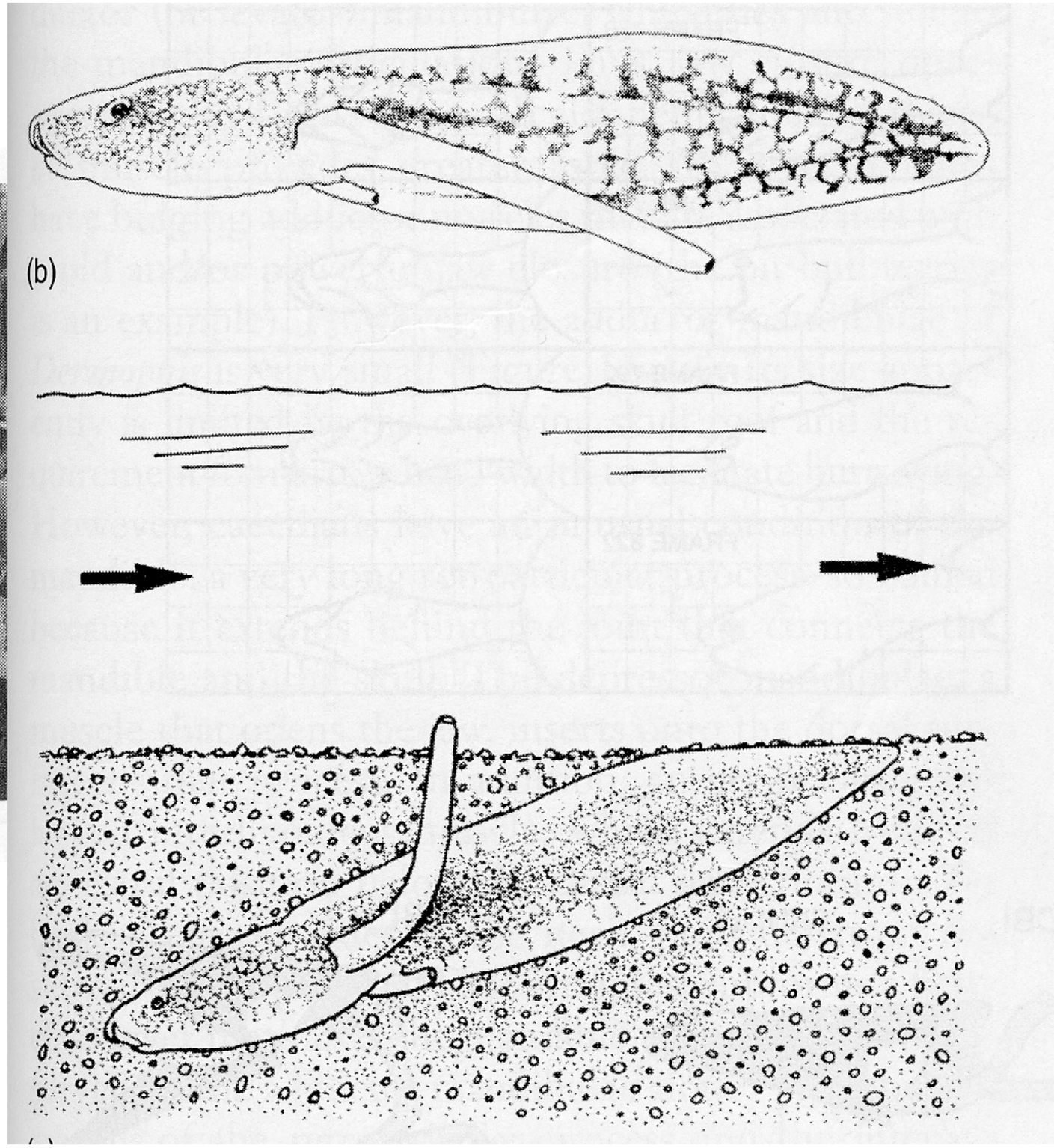
Tailed frog
Ascaphus truei



Otophryne robusta
S. American microhylid

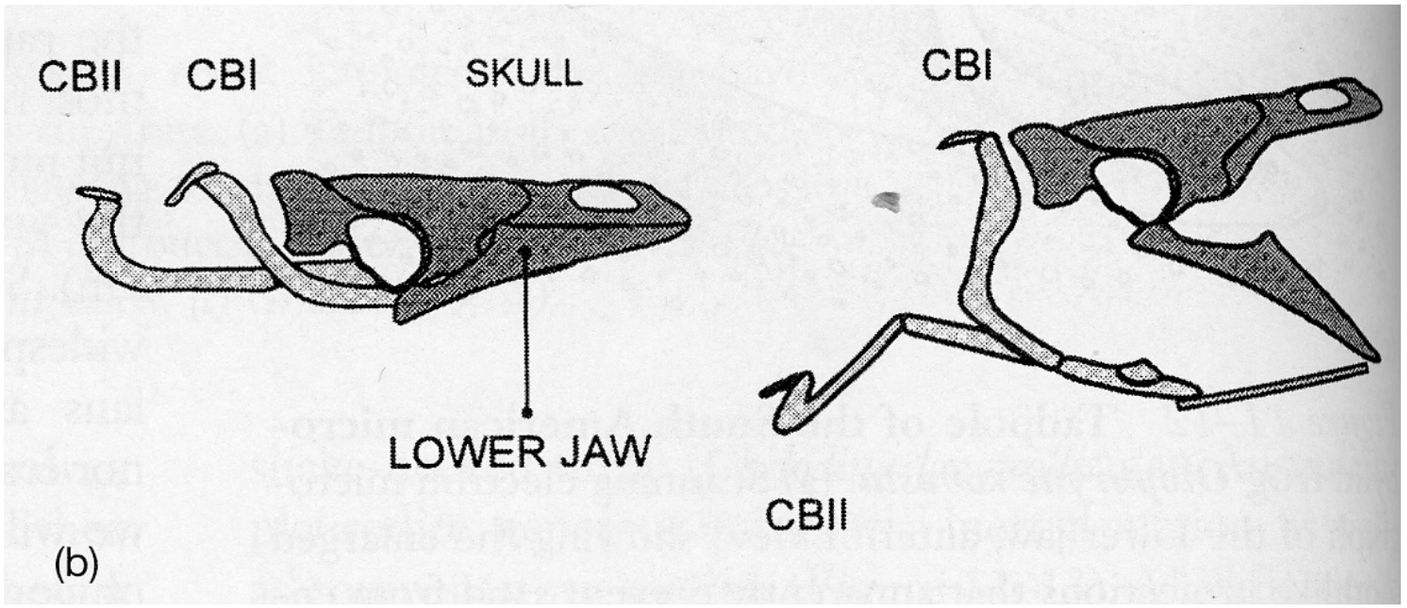


Otophryne robusta
S. American microhylid

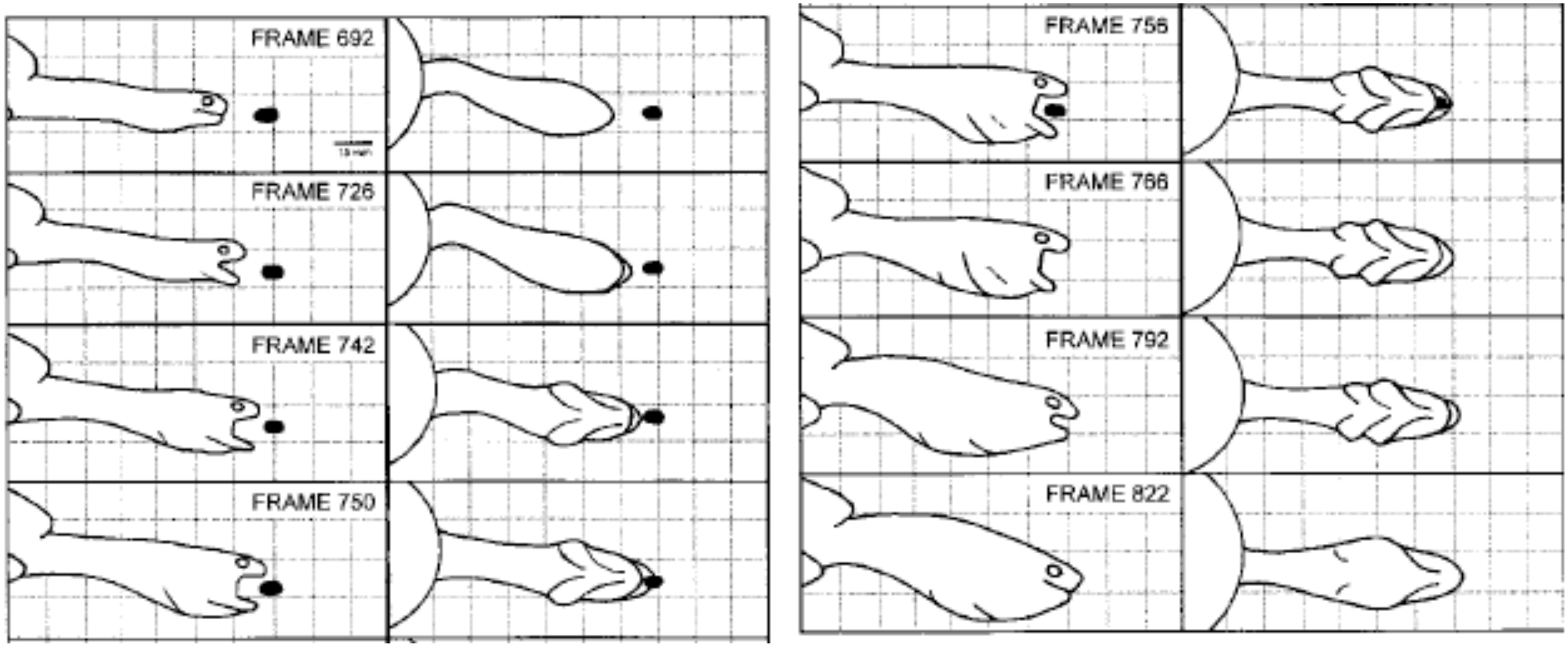


Aquatic turtles

- Use suction feeding
- Compensatory suction only in some species



Hyobranchial apparatus
(Ceratobranchial I and II)



Van Damme and Aerts 1997

Feeding

- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile
- Feeding on plants: **herbivory**

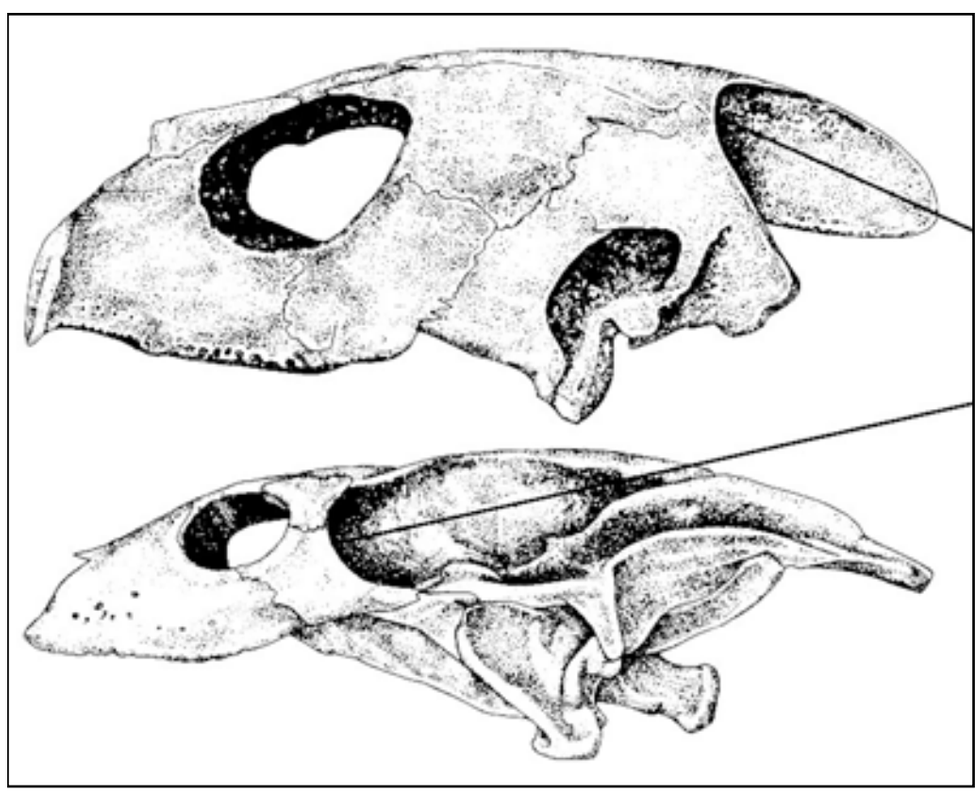
Terrestrial Feeding

- Depends on skull kinetics
- Anapsids & burrowers have rigid skulls
- Akinetic feeding

Terrestrial Feeding

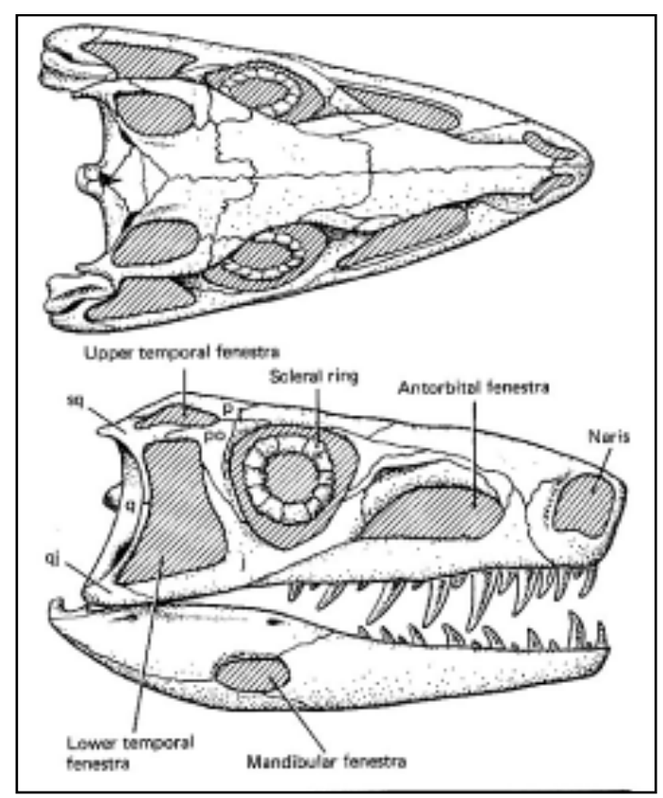
- Depends on skull kinetics
- Anapsids & burrowers have rigid skulls
- Akinetic feeding

Anapsid



Pough et al. 1998

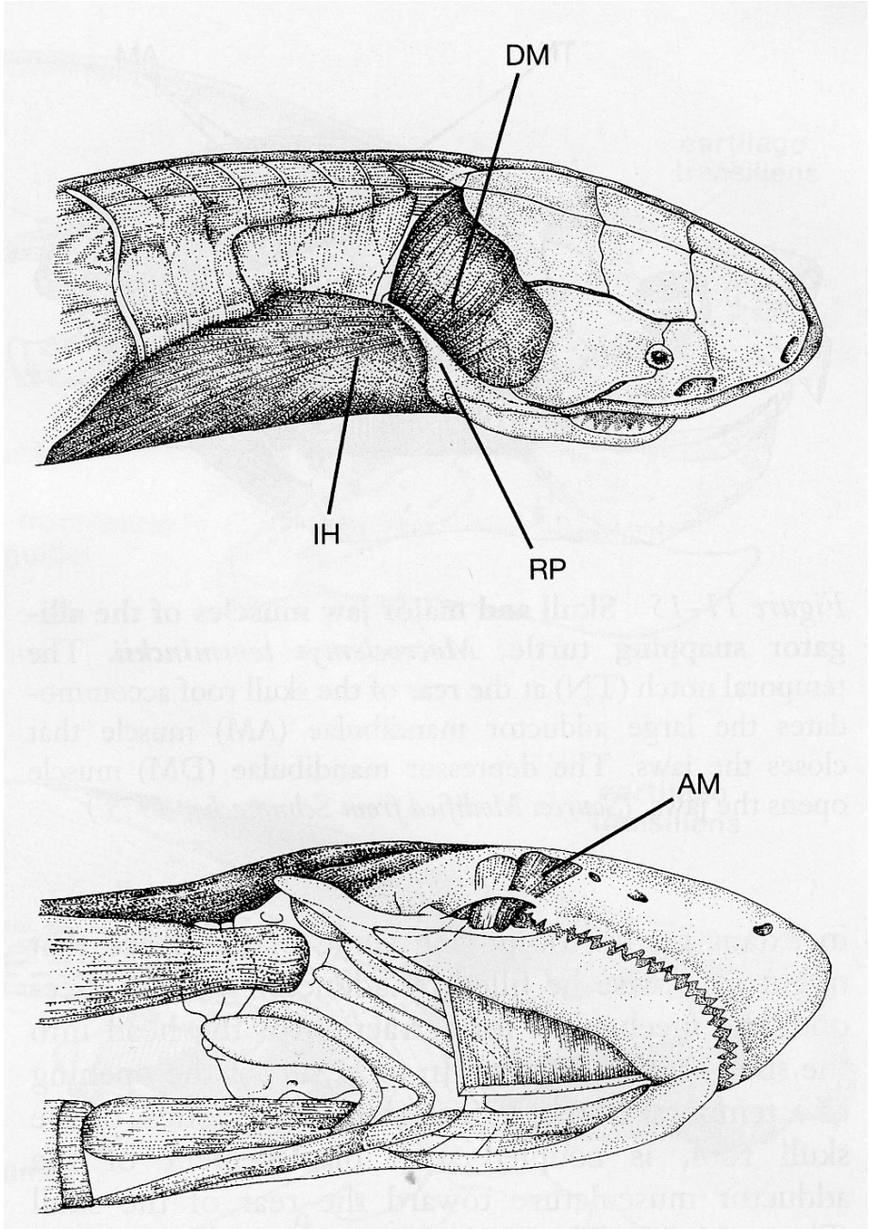
Diapsid



Pough et al. 1996

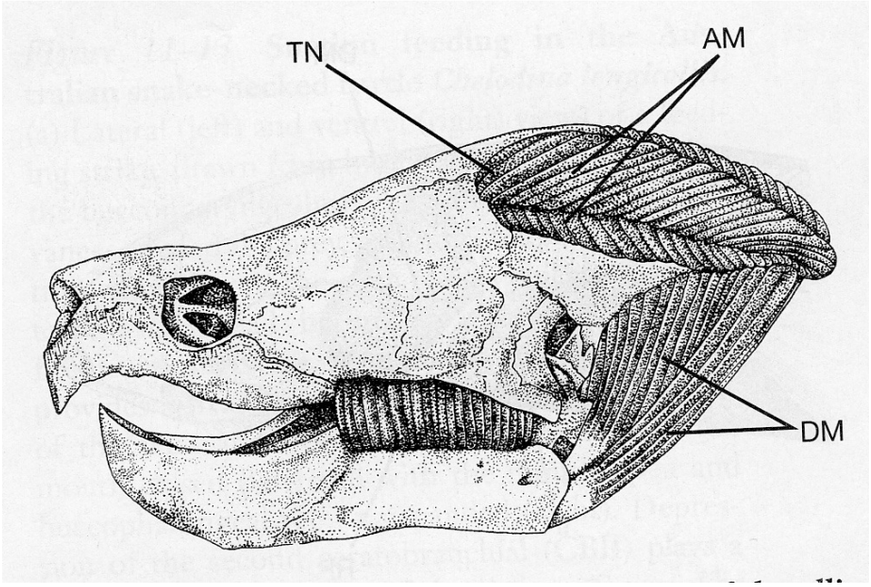
Caecilian Feeding

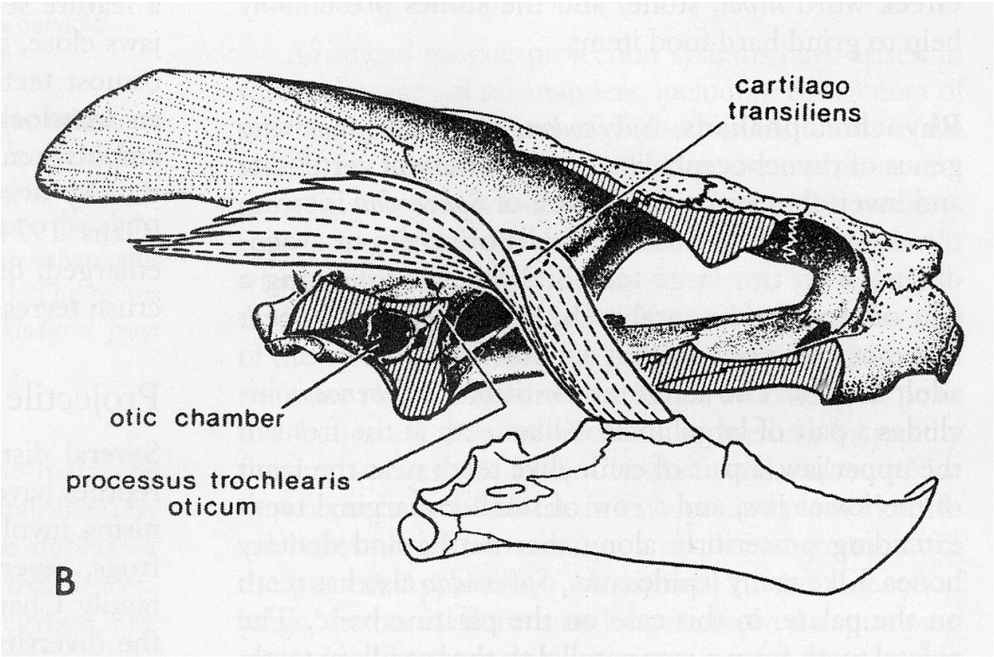
- Skull heavily fortified for digging
- Adductor mandibulae is small
- Muscles relocated to side of skull
- Weak biters, slow feeders



Turtle feeding

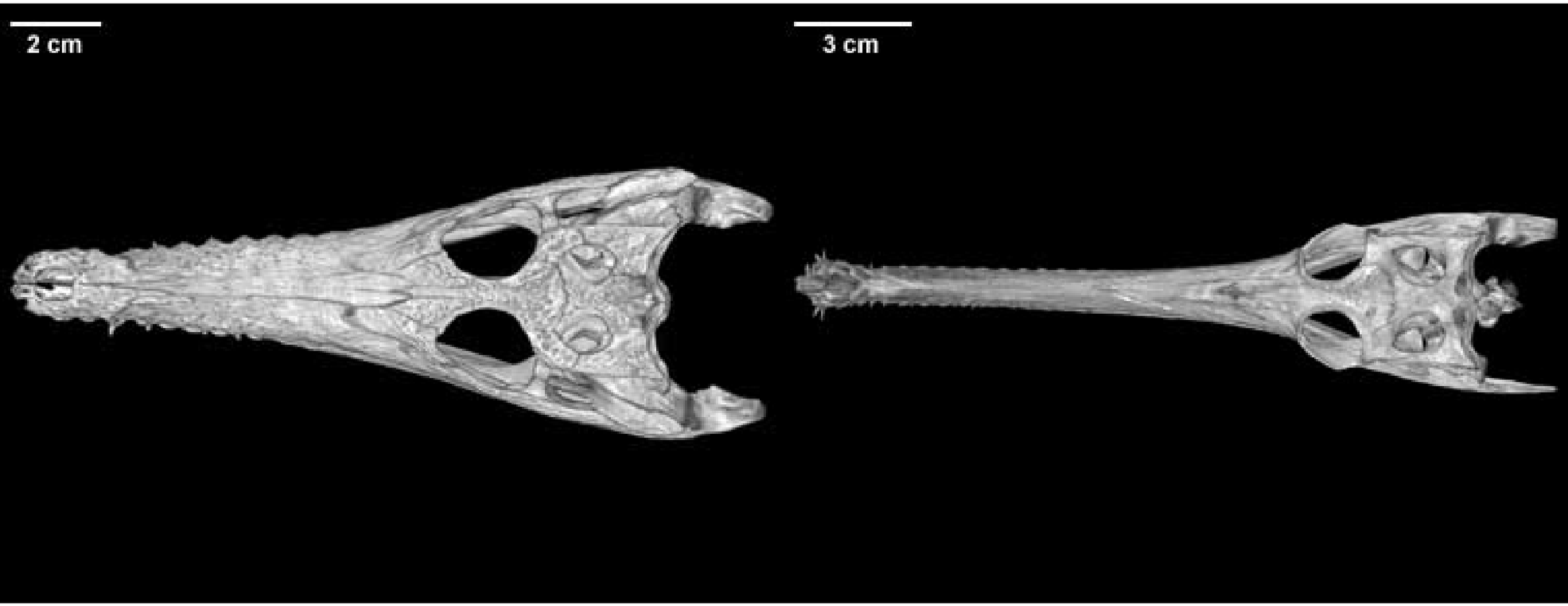
- Most heavily built skulls among reptiles
- Large adductor mandibulae muscle, between braincase and skull
- Pulley system to allow space for head retraction





Crocodilians

- Open mouth by lifting head, not lowering jaw
- These muscles are relatively weak - can hold a croc’s mouth shut
- Massive pterygoideus muscles
- Snout shape correlated with diet



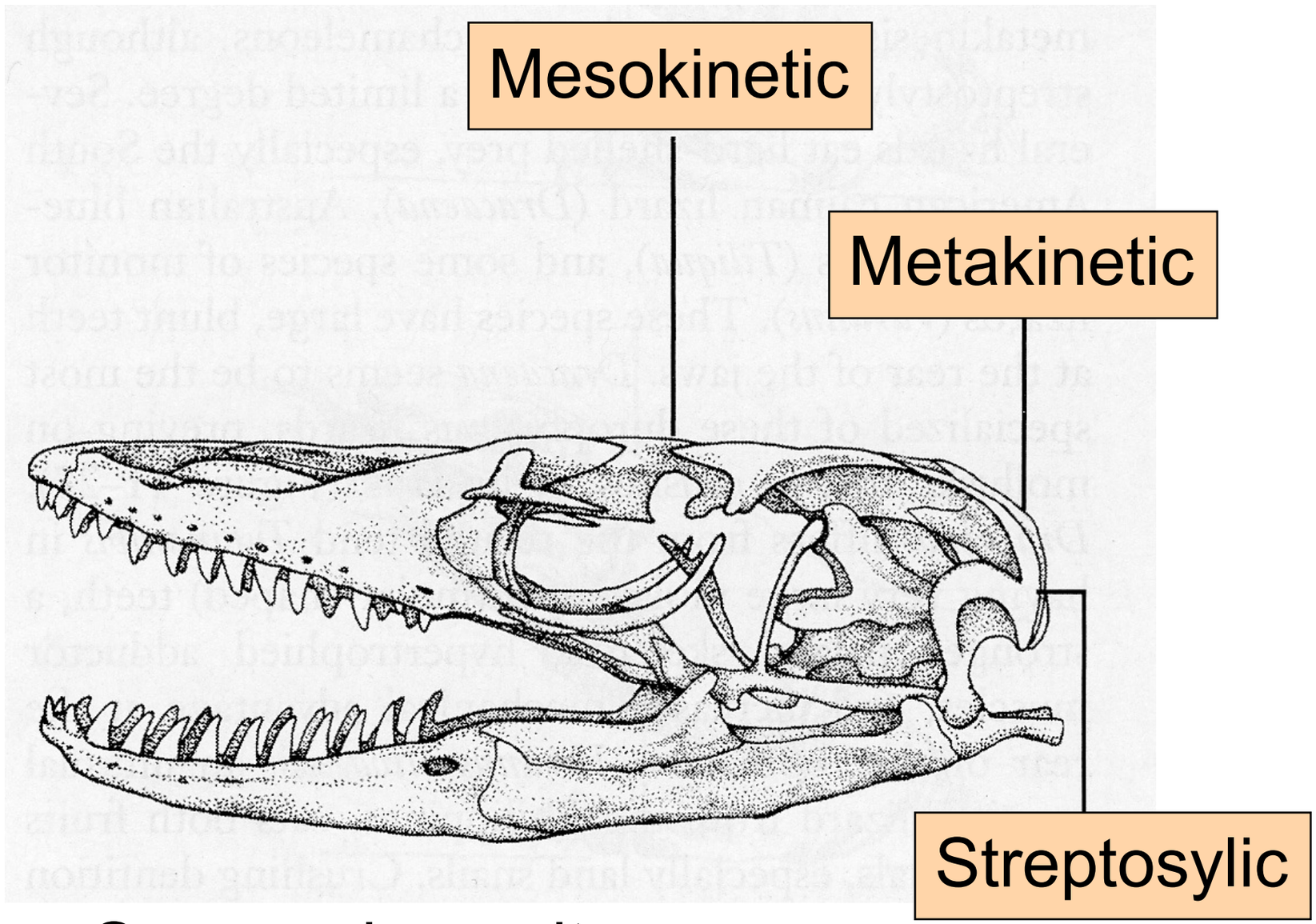
Crocodylus johnstoni,
Australian Freshwater Crocodile

Gavialis gangeticus, Indian Gharial

Feeding

- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile
- Feeding on plants: **herbivory**

Kinetic skulls



Savannah monitor
Varanus exanthematicus

Kinetic skulls

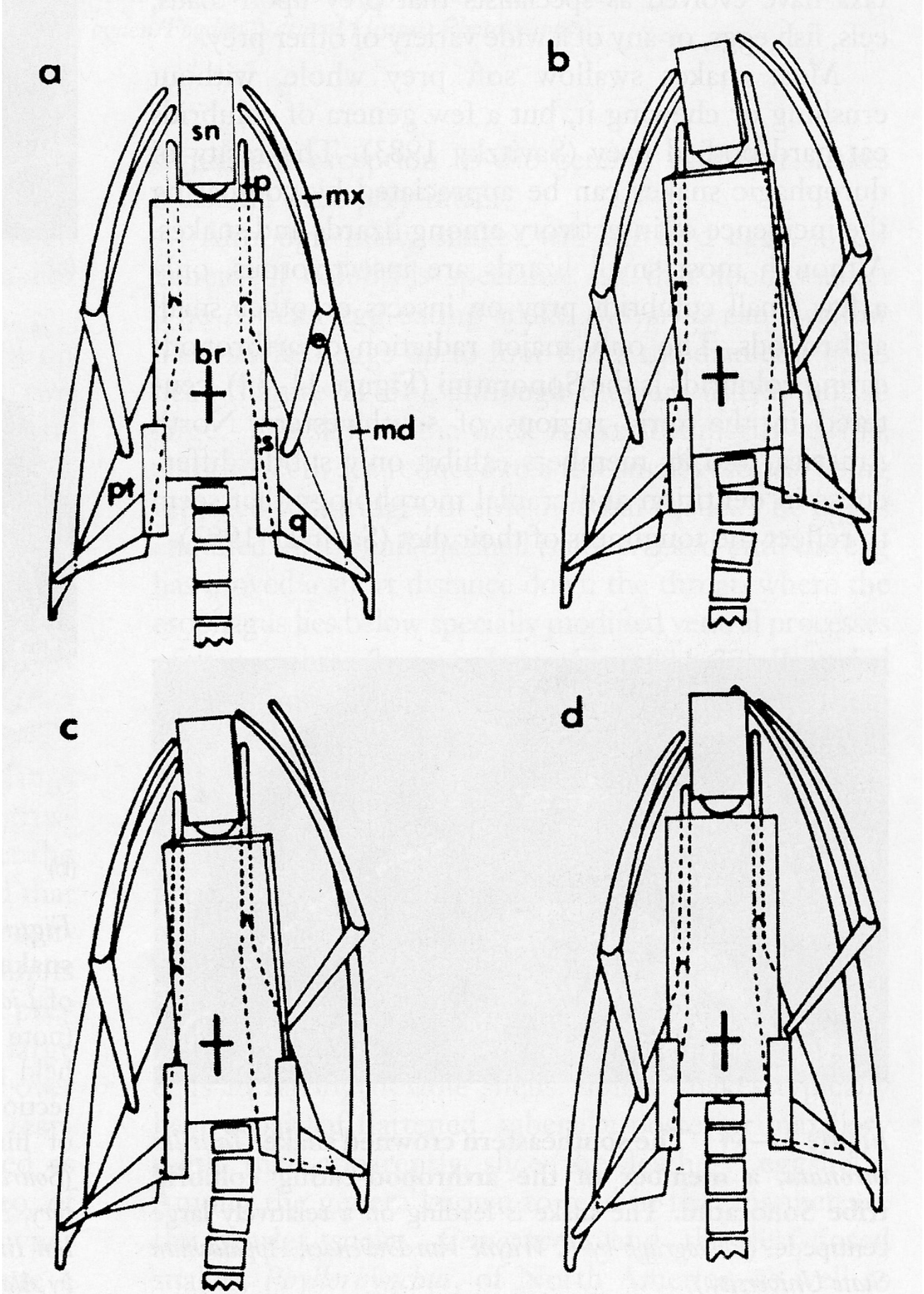
- Increase bite force (example: streptostyly)
- Increase gape
- Mold mouth shape to prey

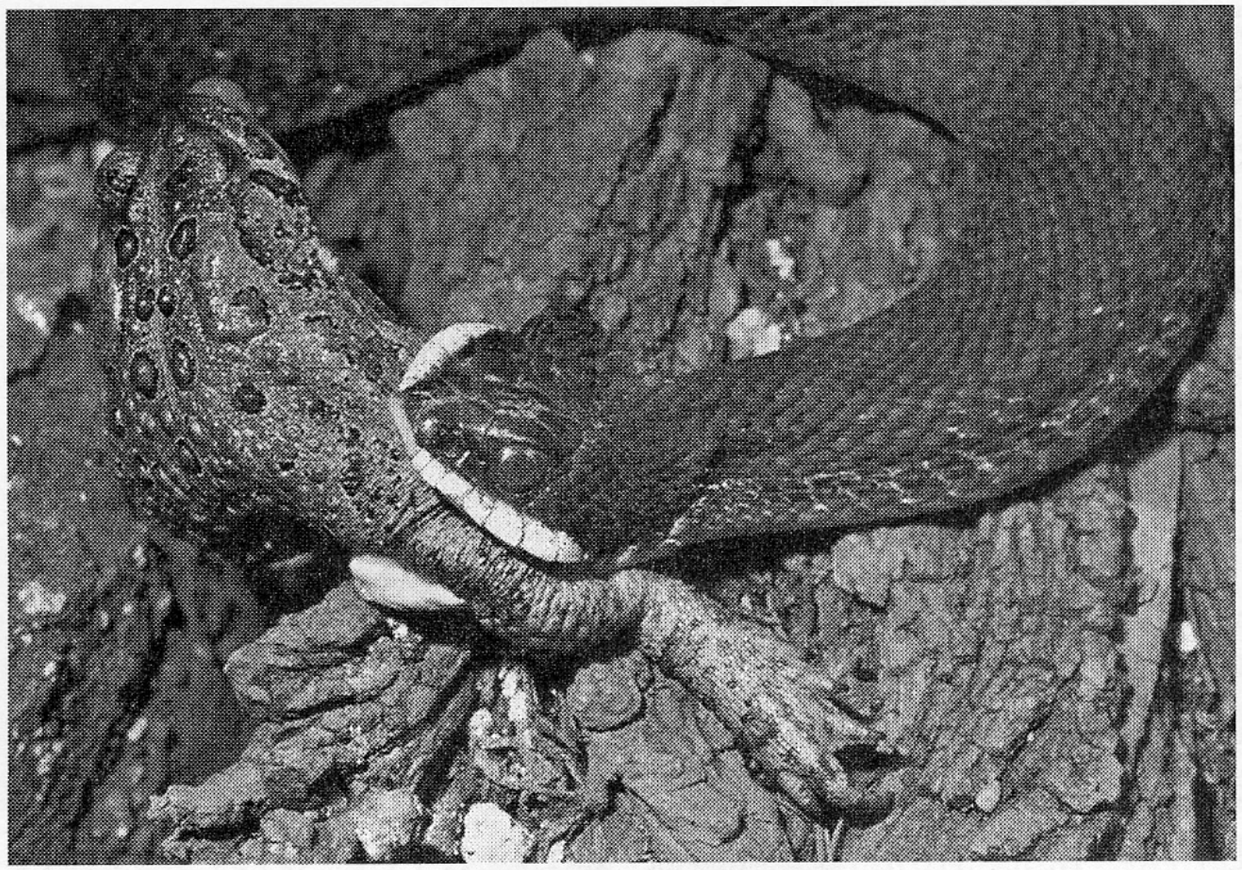
Role of Tongue

- Iguanians:
  - tongue used to capture prey
  - Move food in mouth
- Scleroglossans:
  - tongue mainly chemosensory
  - Use inertial feeding

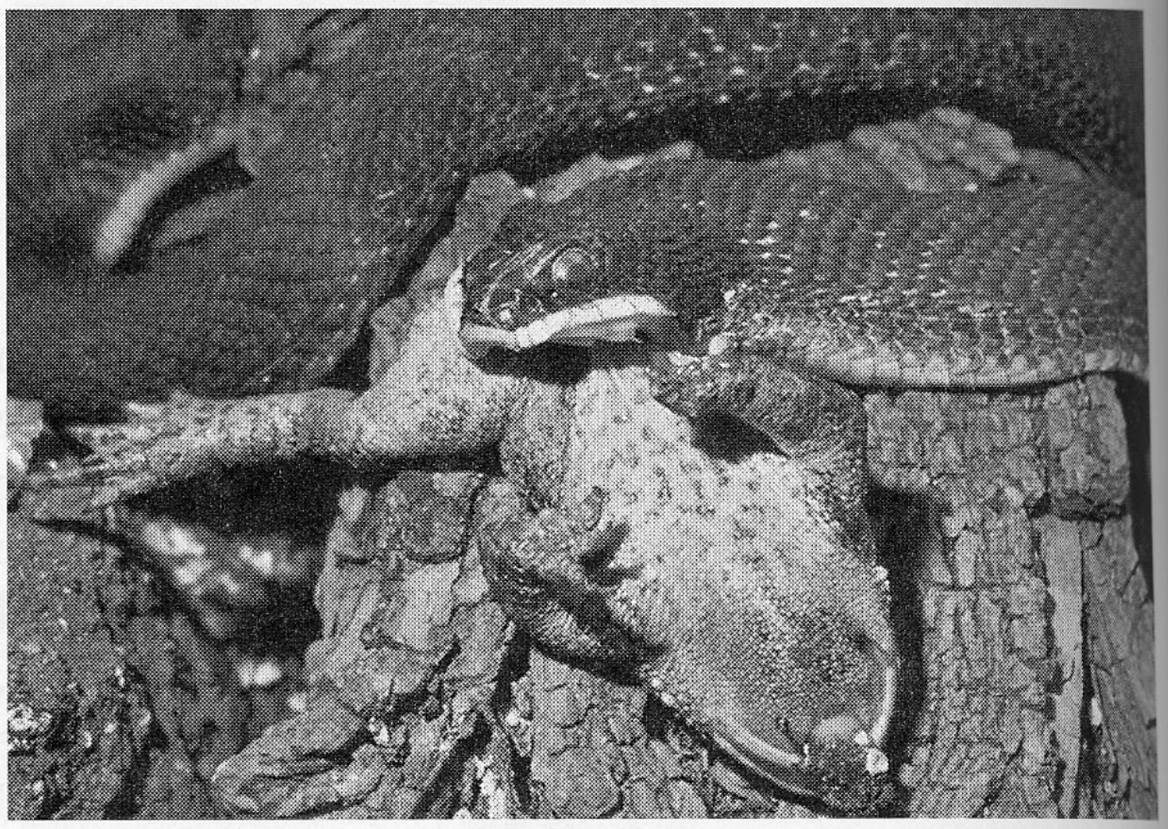
Snake Skull Kinesis

- Highest among tetrapods
- Helps handle large prey
- Unilateral feeding - left and right jaws move independently


a
sn
p
mx
br
md
s
pt
q
b
c
d



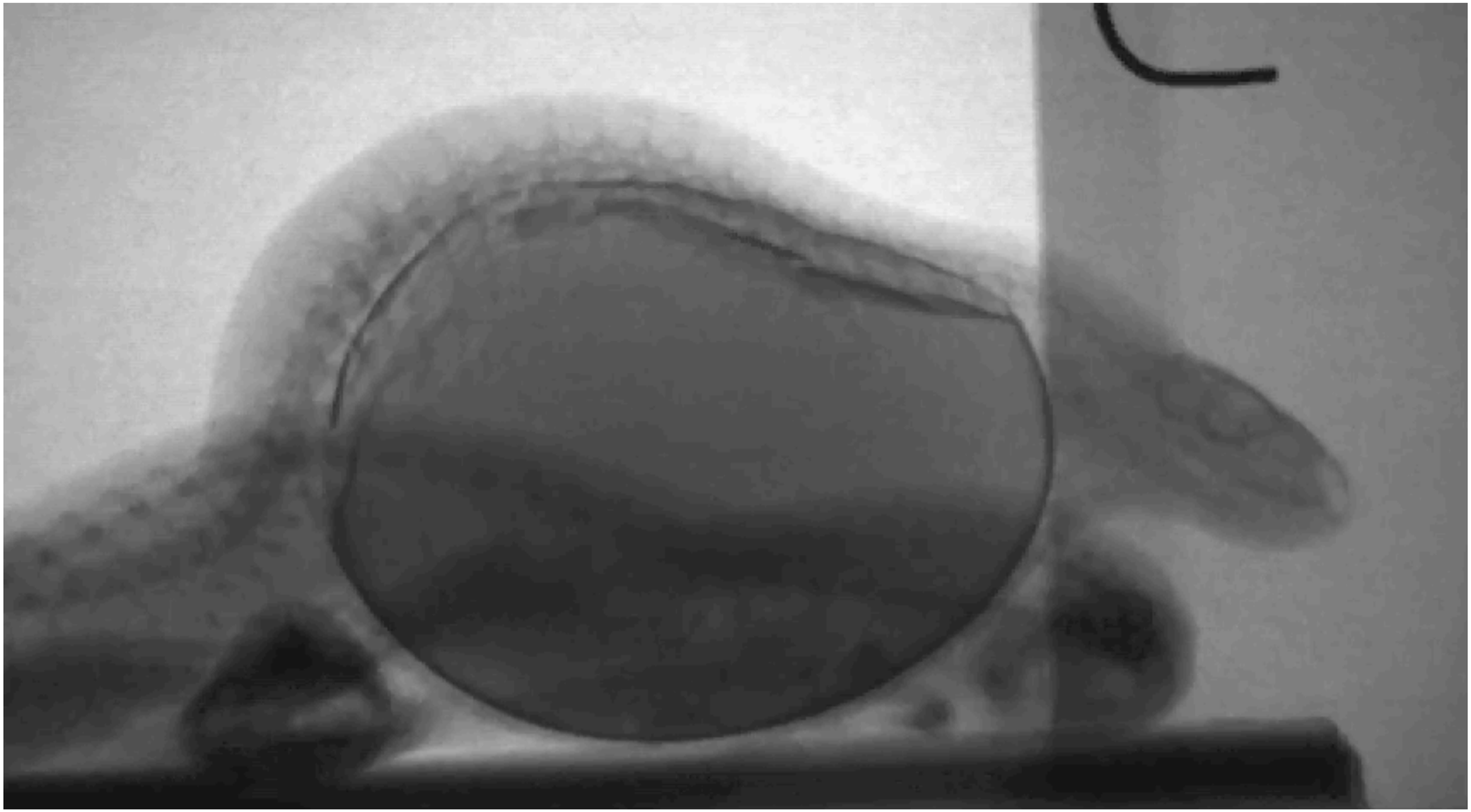
(a)

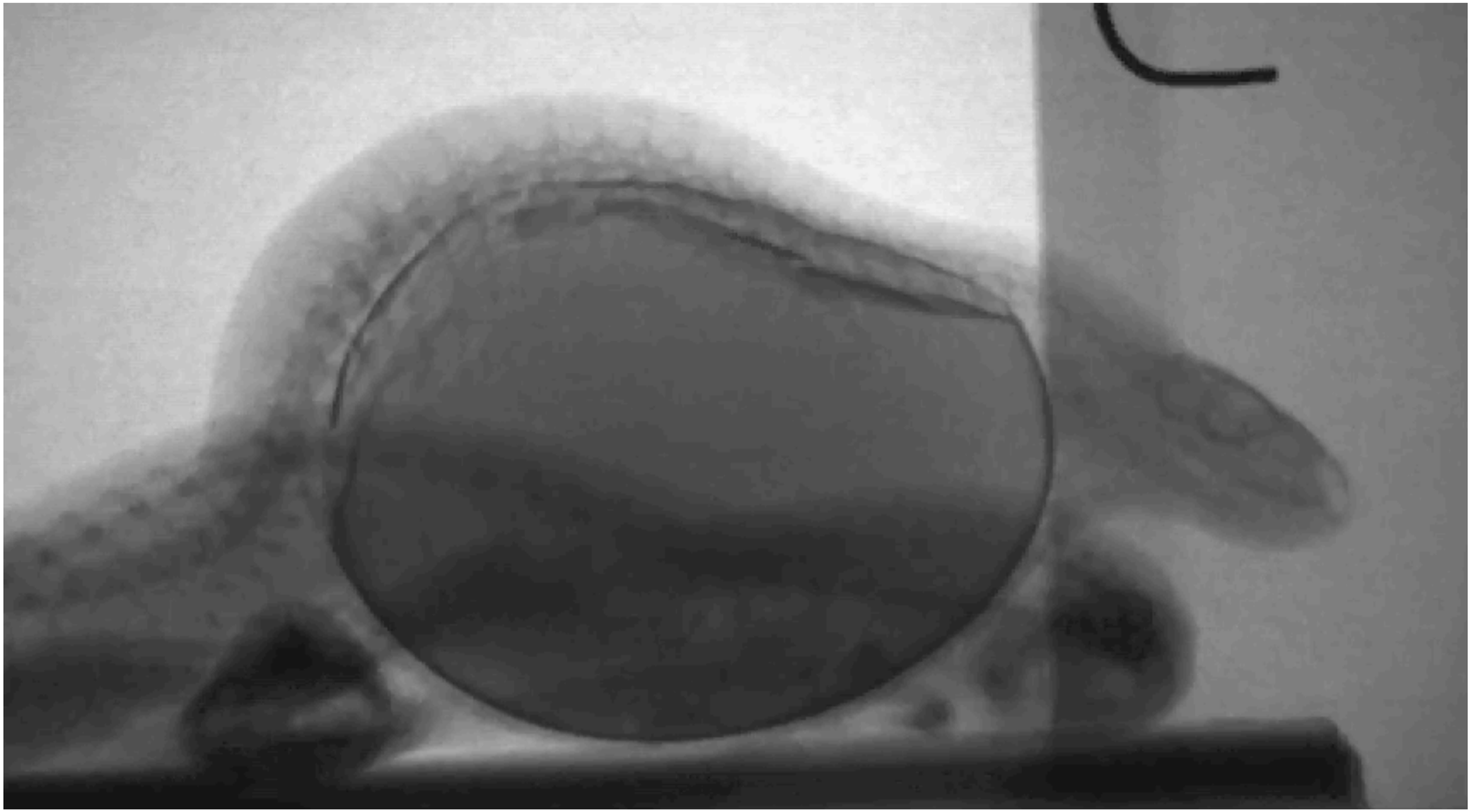


(b)

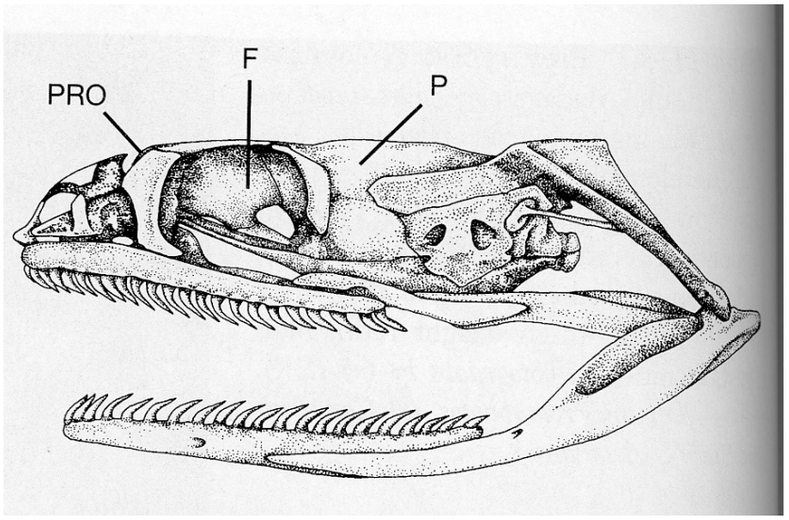
Nerodia fasciata

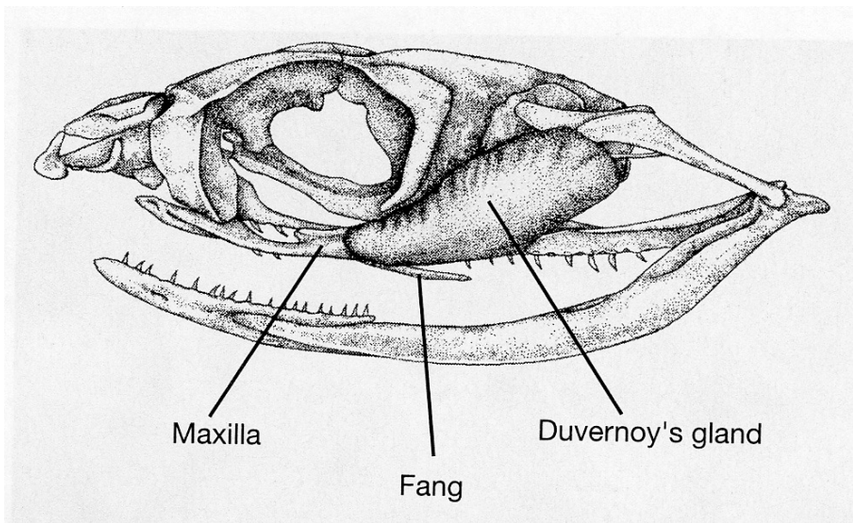
Nerodia fasciata

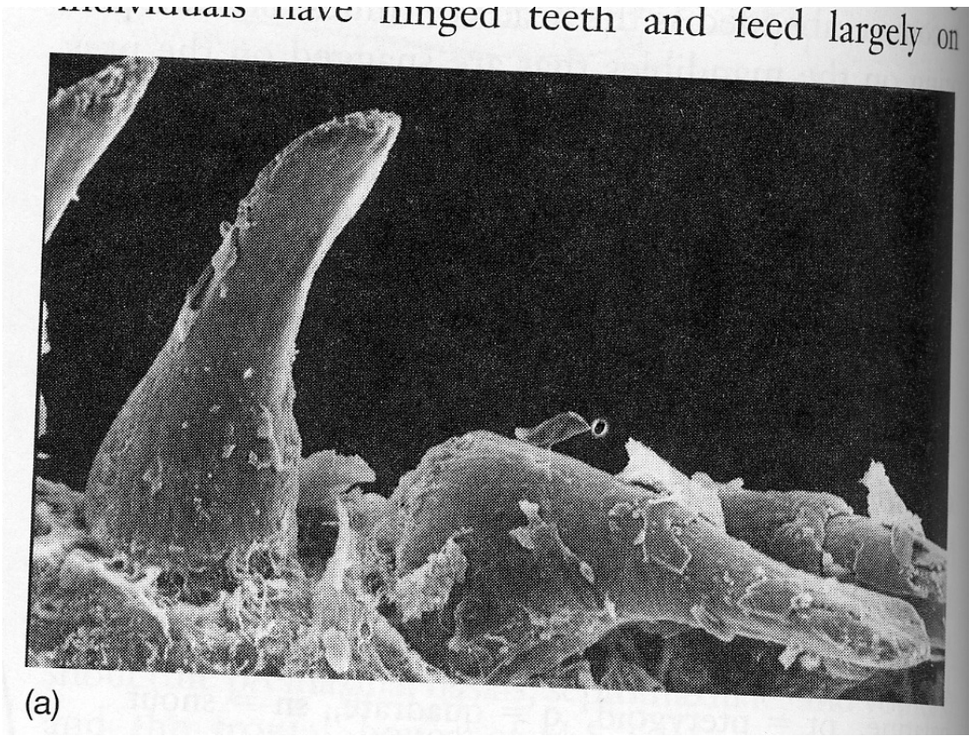


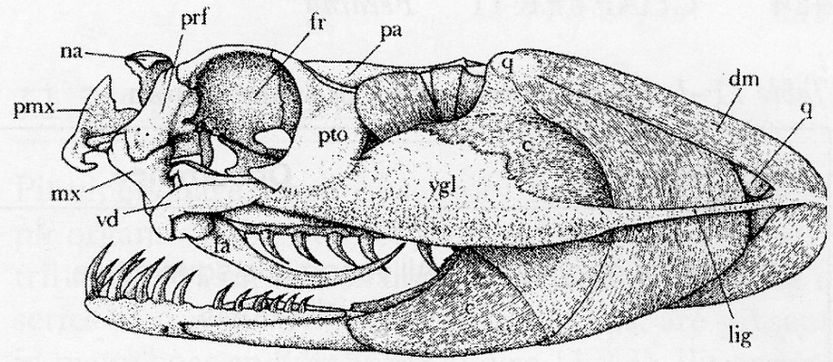


Hinged teeth

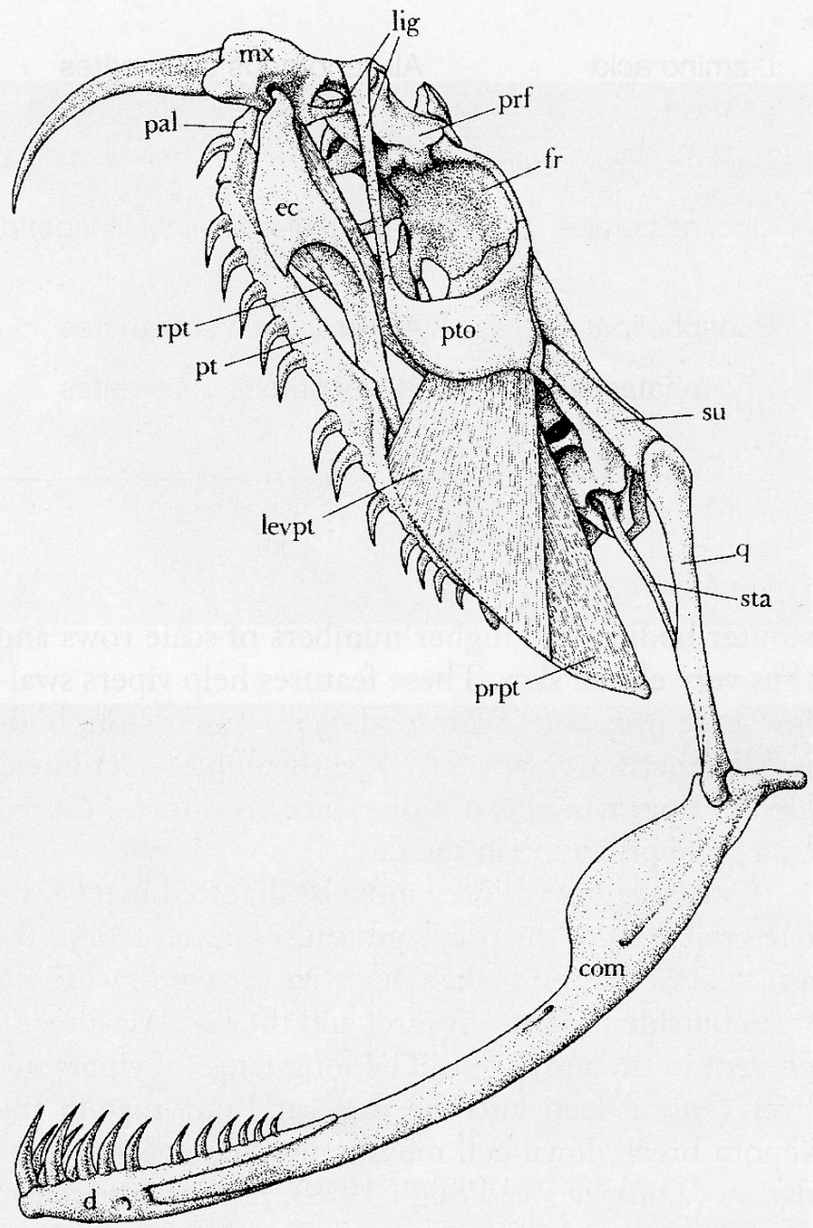






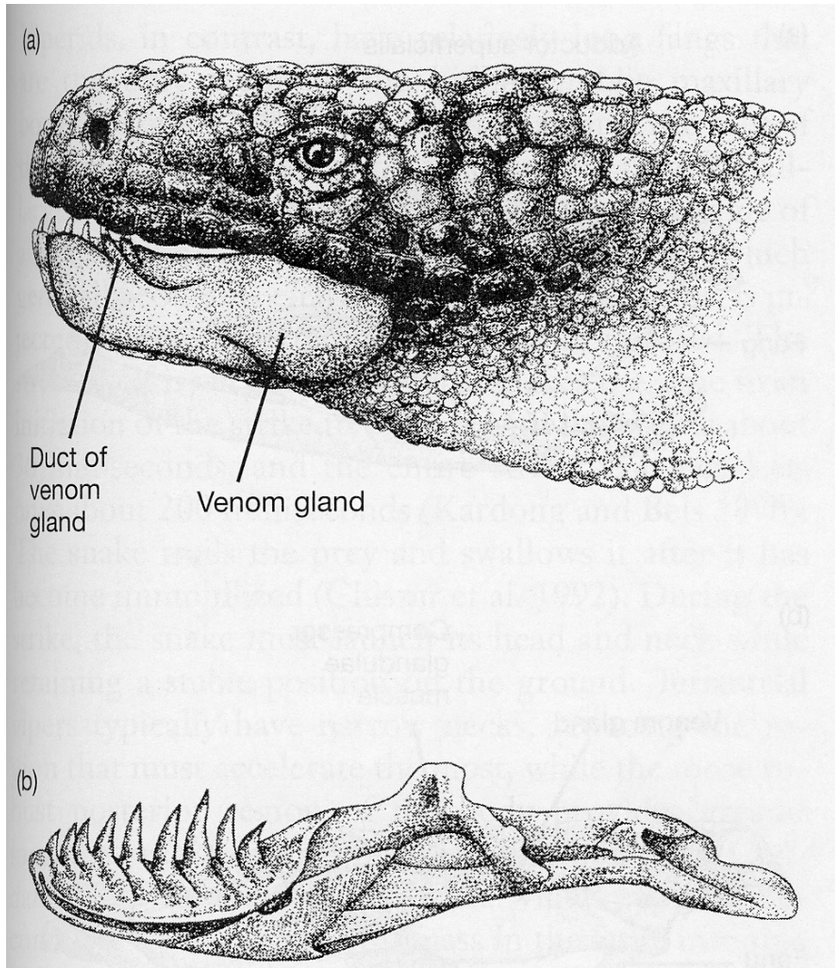

prf
fr
pa
na
q
dm
pmx
q
pto
c
ygl
mx
vd
la
c
lig

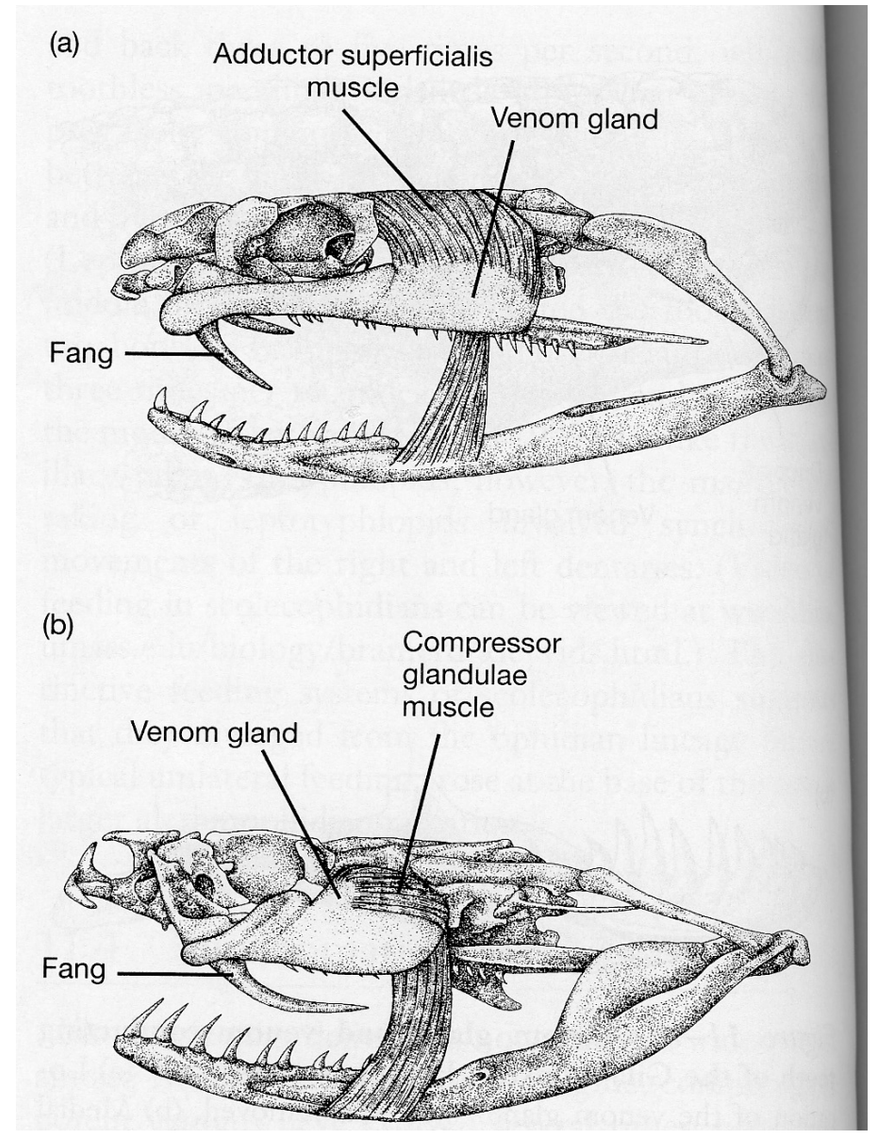
a)


lig
mx
prf
pal
fr
ec
rpt
pto
pt
su
levpt
q
sta
prpt
com
d

b)

Envenomation

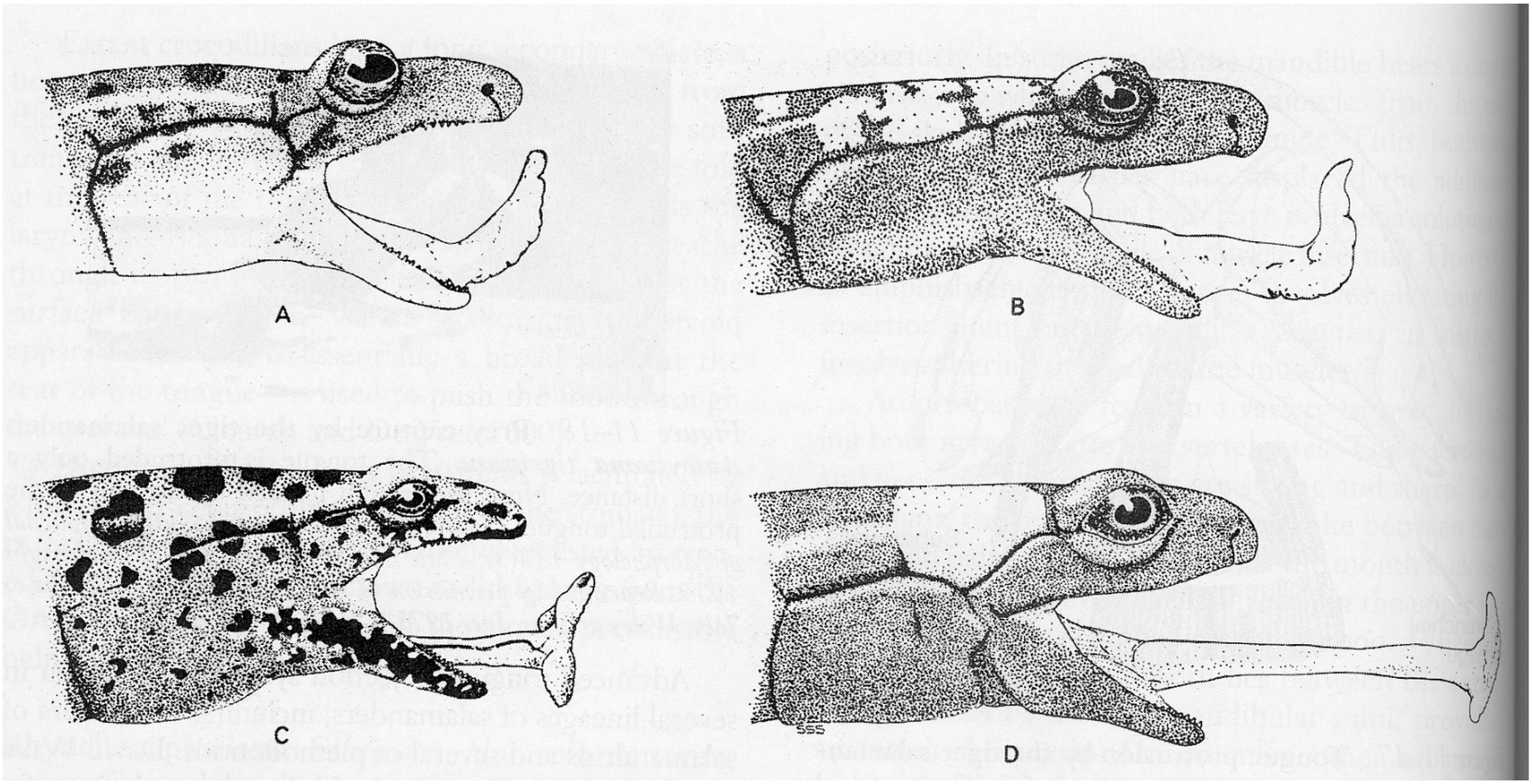


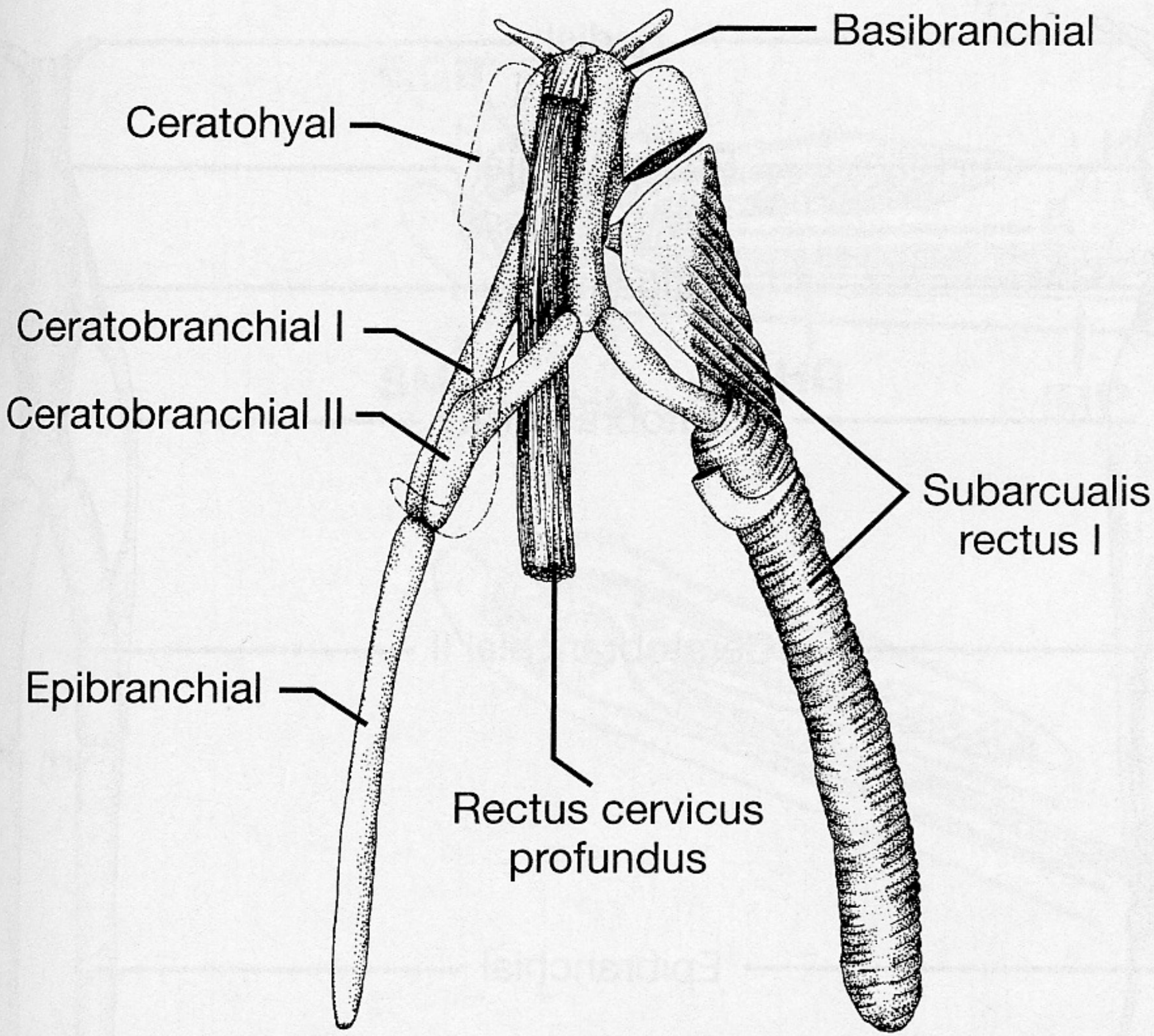


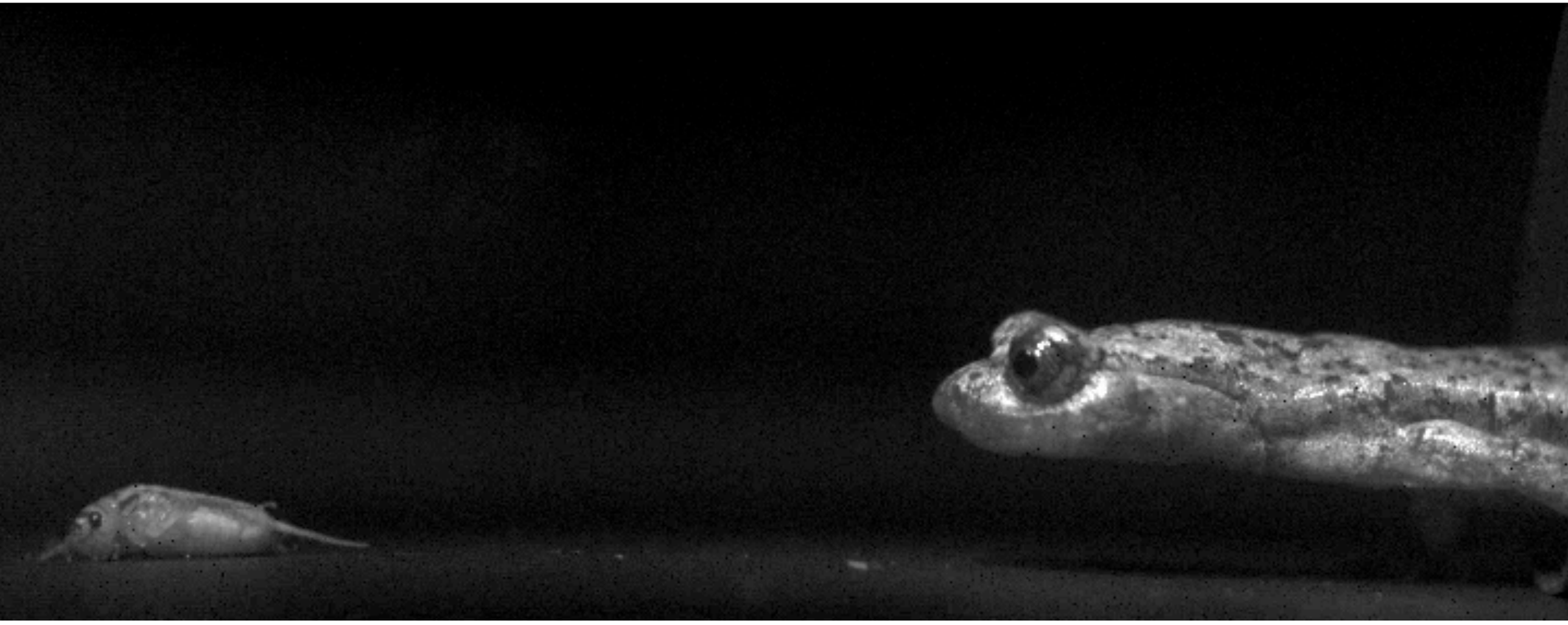
Feeding

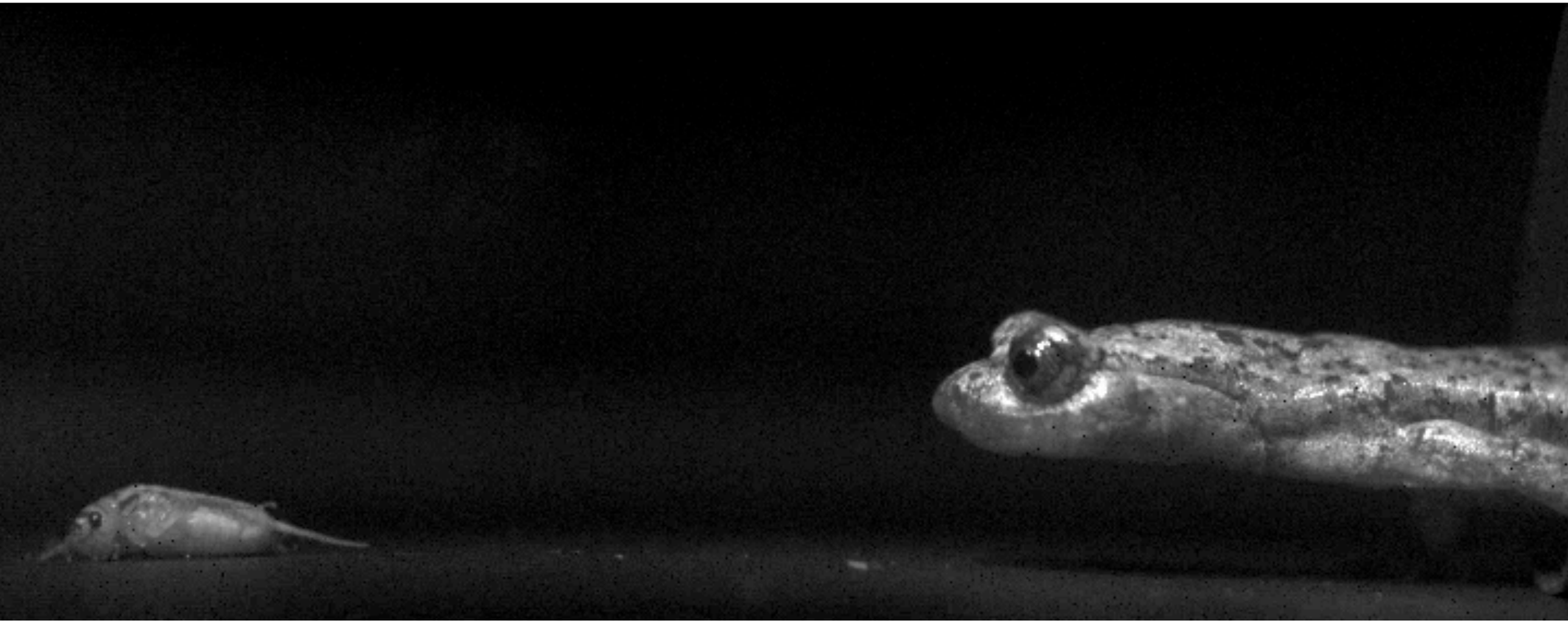
- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile
- Feeding on plants: **herbivory**

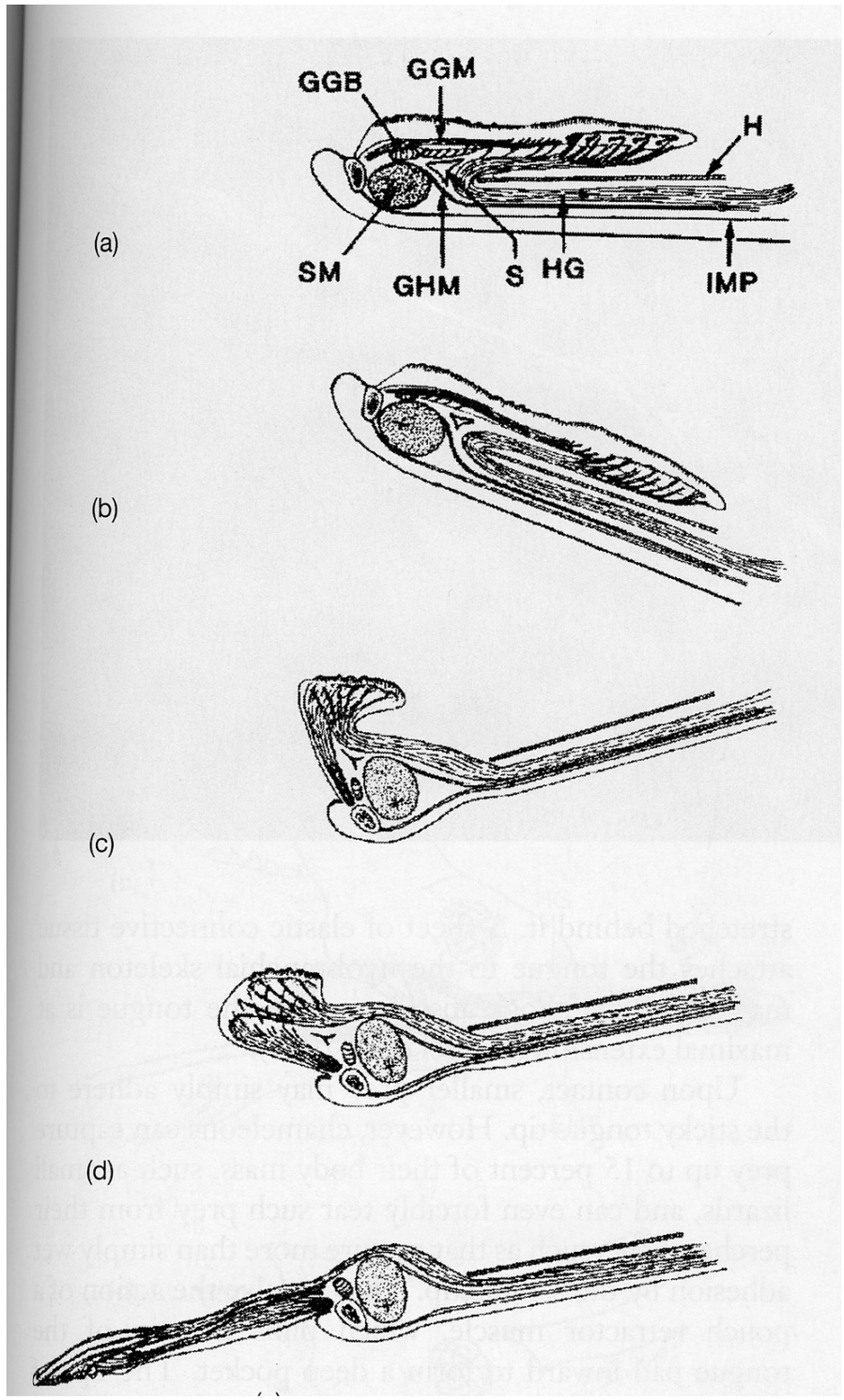
Projectile feeding

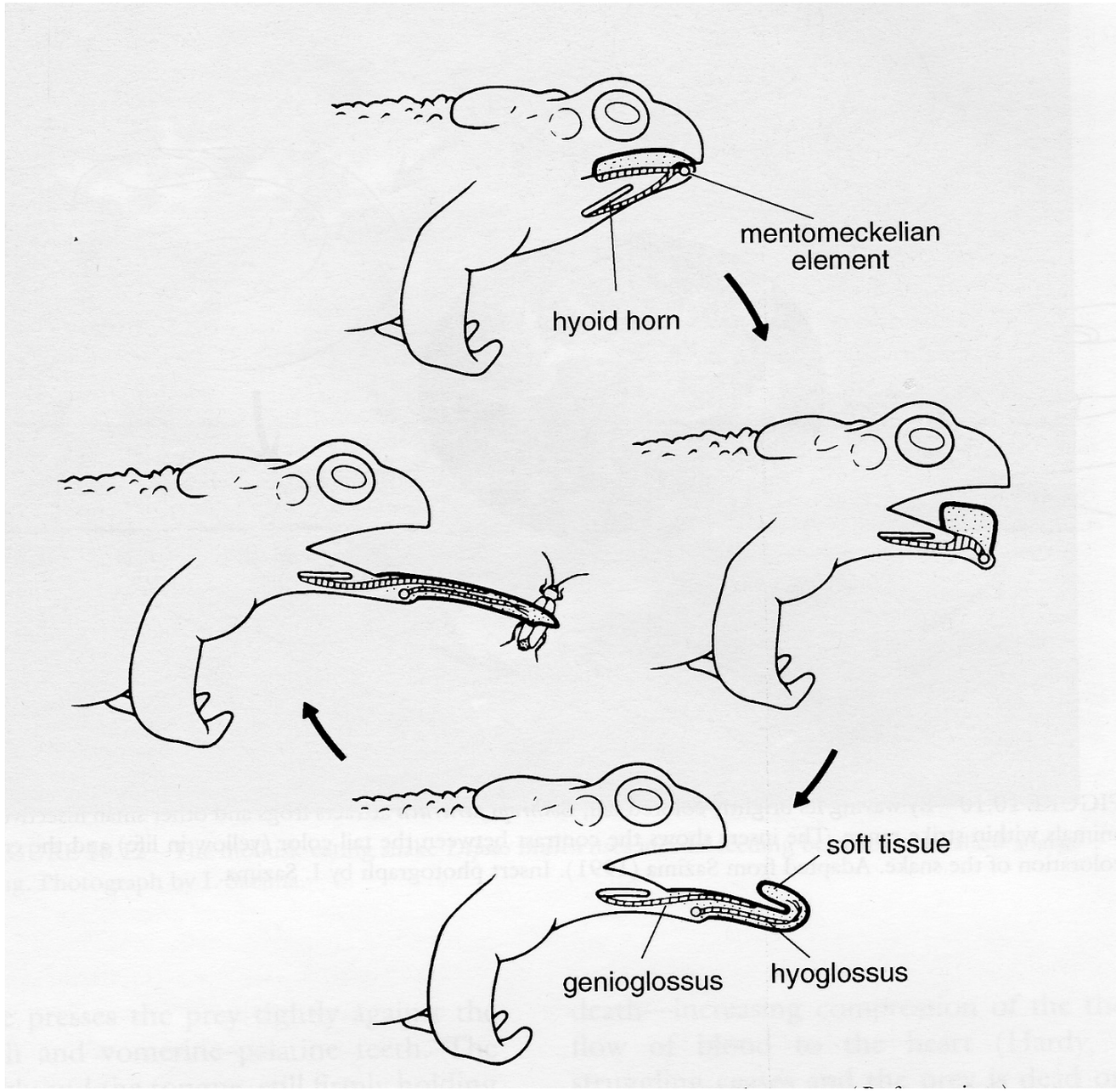



Basibranchial
Ceratohyal
Ceratobranchial I
Ceratobranchial II
Subarcualis rectus I
Epibranchial
Rectus cervicus profundus



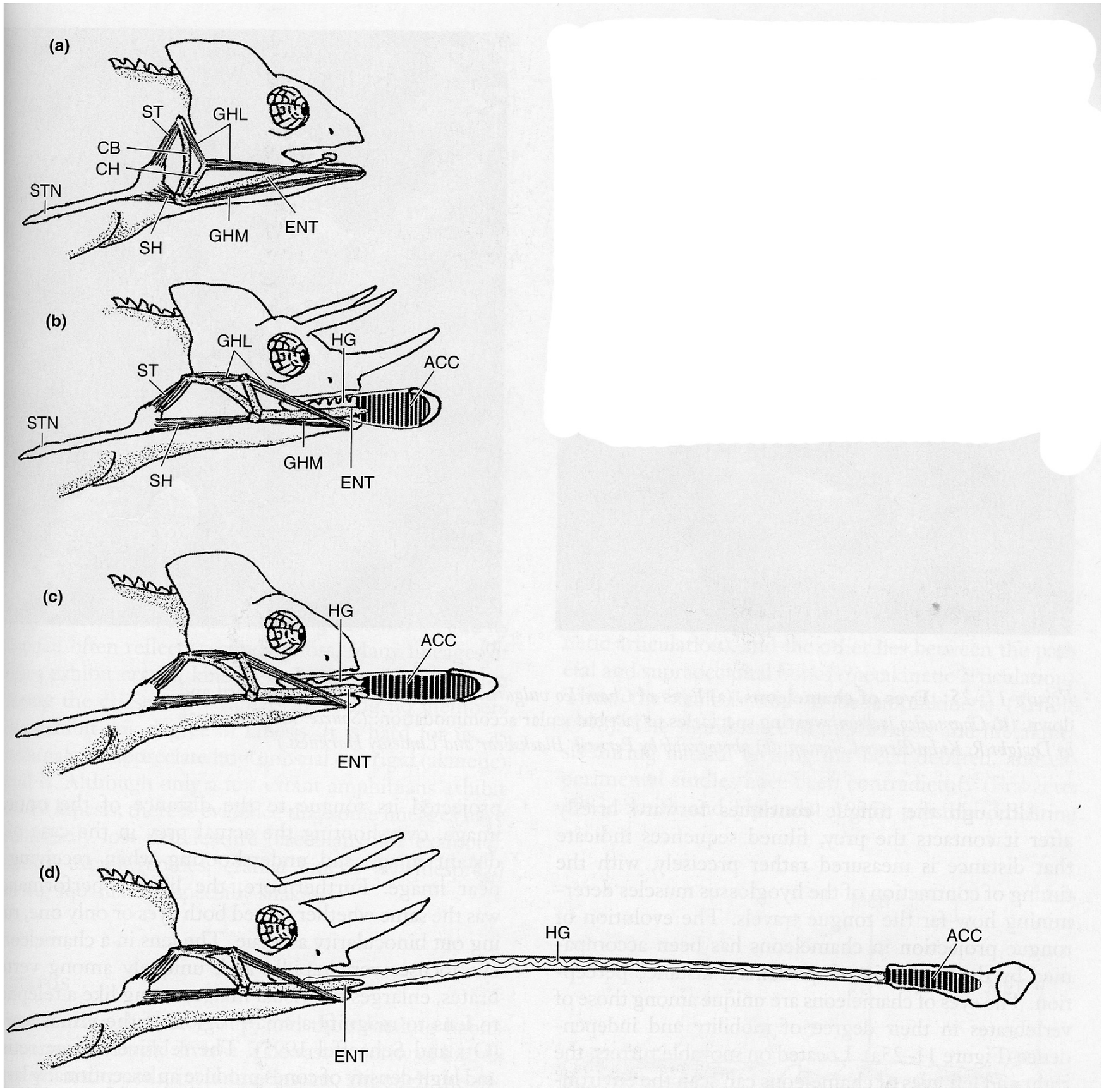


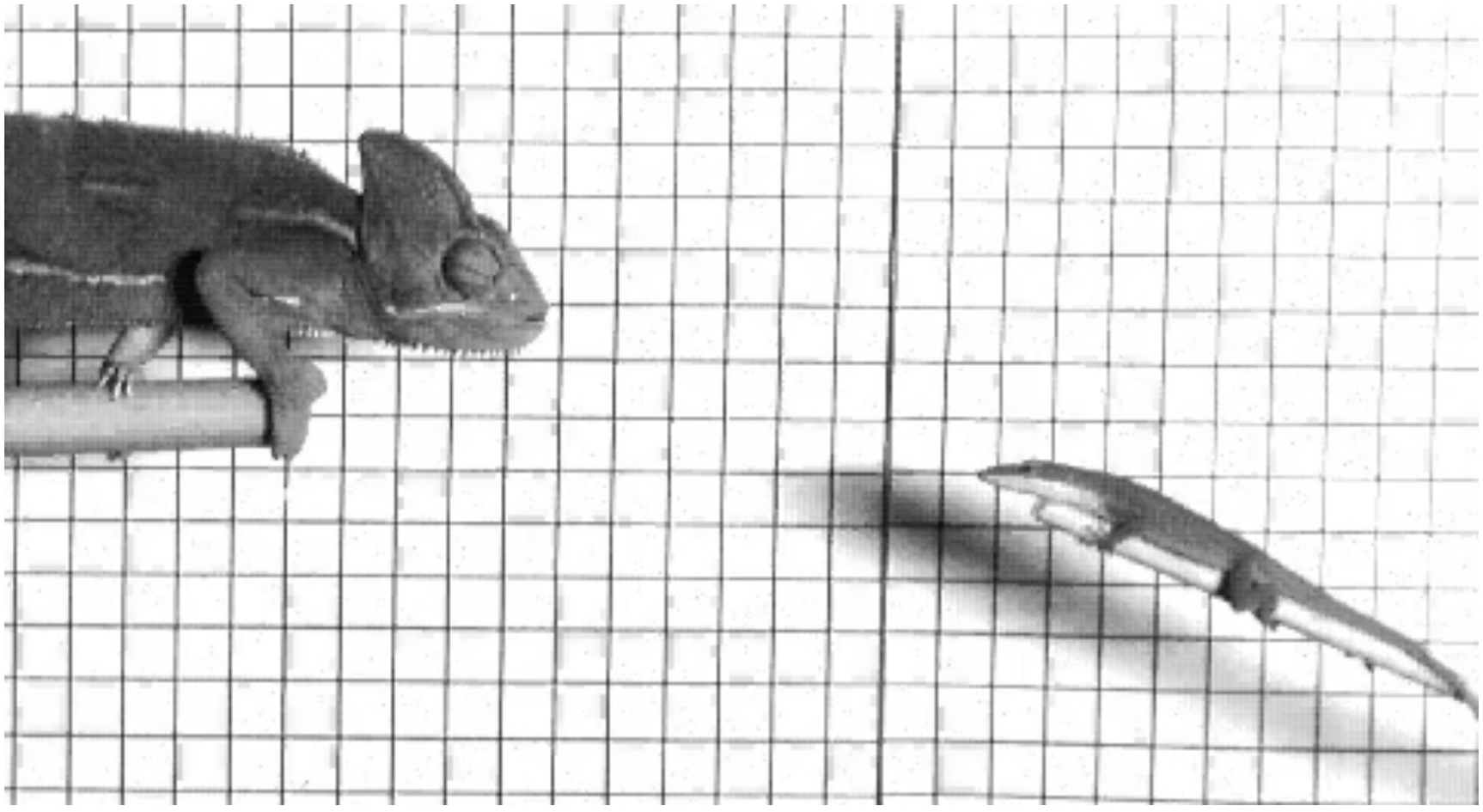

GGB
GGM
H
(a)
SM
GHM
S
HG
IMP
(b)
(c)
(d)

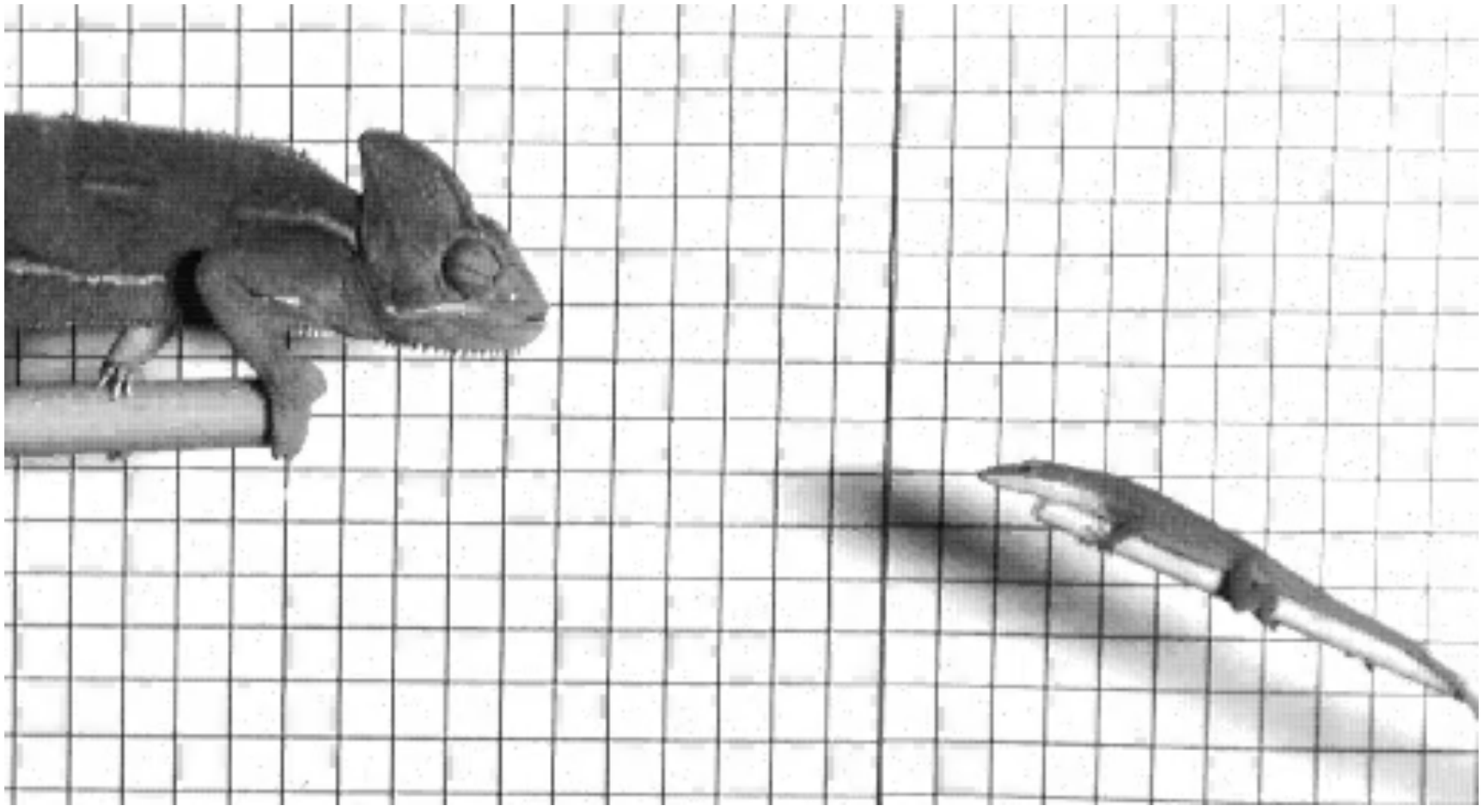

mentomeckelian
element
hyoid horn
soft tissue
genioglossus
hyoglossus

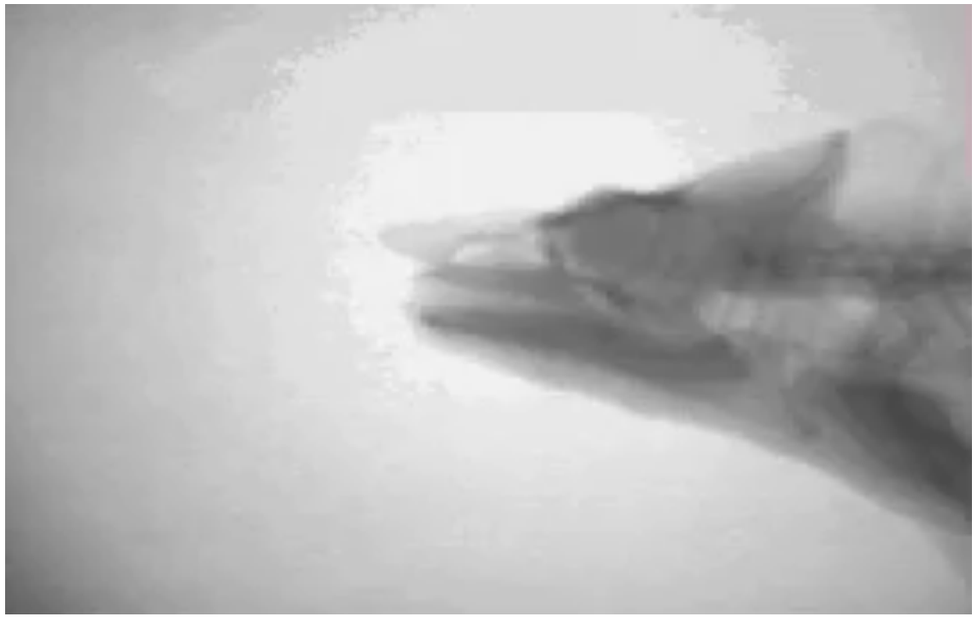
CM
1
2
3

CM
1
2
3

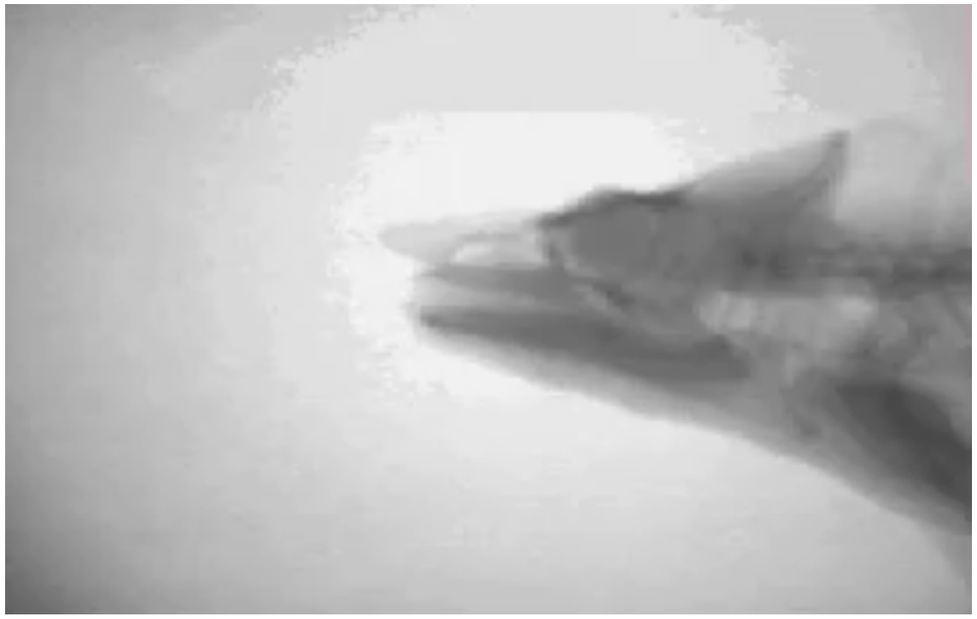

(a)
ST
GHL
CB
CH
STN
SH
GHM
ENT
(b)
GHL
HG
ACC
ST
STN
SH
GHM
ENT
(c)
HG
ACC
ENT
(d)
HG
ACC
ENT



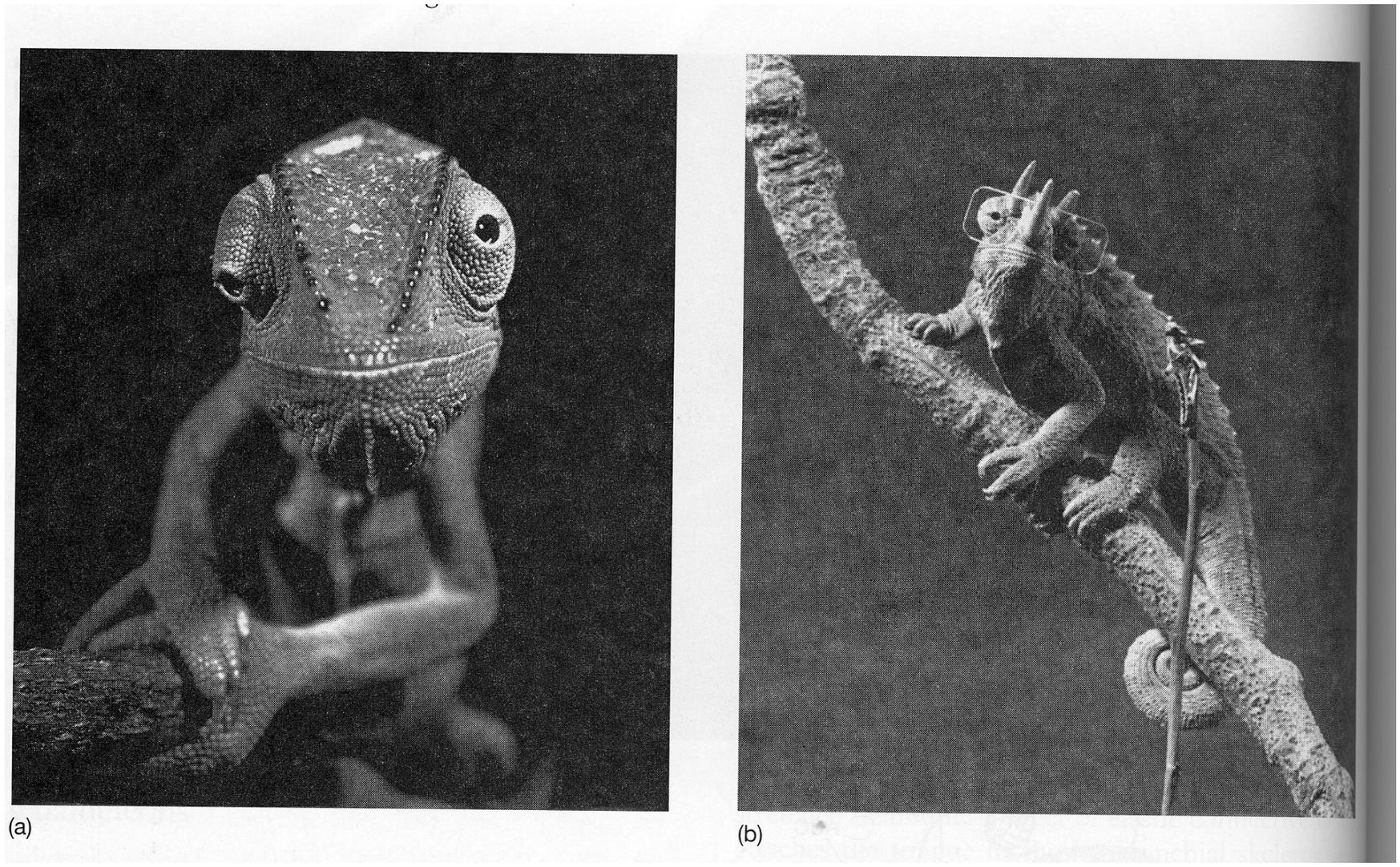




Chameleo melleri



Chameleo melleri



- Chameleons use focal depth to catch prey

Feeding

- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile

- Feeding on plants: **herbivory**

Adaptations to Herbivory

- Enlarged colon, sometimes with valves
- Modified teeth
- Large body size
- Symbiotic fermenters

Colon of land iguana
Cyclura cornuta

Feeding

- Feeding in water: **suction**
- Feeding on land
  - Akinetic
  - Kinetic
  - Projectile

- Feeding on plants: **herbivory**